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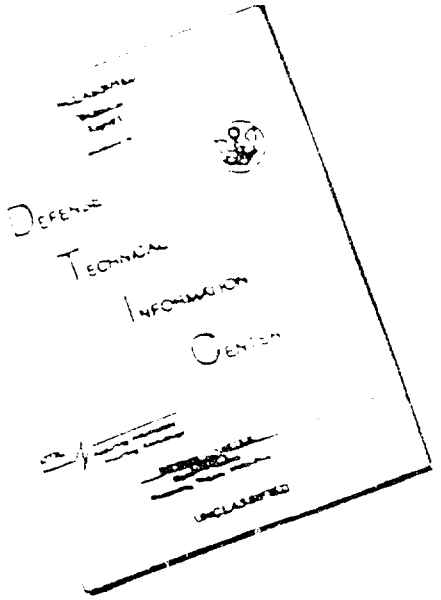

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13. ABSTRACT

There has been considerable emphasis recently on analysis (systems, economic, cost-benefit, etc.) in government decisionmaking activities. One approach which is currently popular is the Planning-Programming-Budgeting System (PPBS). PPBS is often described as a means of helping responsible officials make decisions. The implication of the system is that it interrelates the planning, budgeting, and decisionmaking functions.

Regardless of the name of the system presently in use, the relationships among these three management activities is of primary importance. This paper develops a methodology to aid the educational process of future decisionmakers in their efforts to integrate quantitative and non-quantitative aspects bearing on planning, budgeting, and decision problems.

The final product is a case study in force structure analysis (FORSTRAN). Participants are required to define the status of the current strategic retaliatory forces as described in a scenario and then make decisions as to future requirements and methods of achieving those requirements. A set of computer programs is furnished to remove the necessity of routine mathematical computation and free the student to more thoroughly consider the non-quantitative aspects of the problem. The case is an exercise in problem-finding as well as problem-solving.

The report concludes that FORSTRAN does provide a viable methodology for teaching future decisionmakers about the relationships developed among governmental planning, budgeting, and decision processes. The case study method of presentation is recommended for classroom use of this problem. Suggestions for further research are also offered.

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A CASE IN FORCE STRUCTURE ANALYSIS

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A CASE IN FORCE STRUCTURE ANALYSIS

THESIS

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PREFACE

THIS THESIS DEVELOPS A METHODOLOGY TO ASSIST EDUCATORS IN TEACHING FUTURE DECISIONMAKERS THE RELATIONSHIPS AMONG GOVERNMENTAL PLANNING, BUDGETING, AND DECISION PROCESSES. THE RESULT IS A CASE STUDY CALLED FORSTRAN, WHICH EMPLOYS FORCE STRUCTURE ANALYSIS AS THE TOPIC TO CONVEY SEVERAL LEARNING OBJECTIVES TO THE STUDENTS. IT HAS EVOLVED FROM AN ORIGINAL SCENARIO DEVELOPED BY LT. COL. CHARLES DORYLAND OF THE SYSTEMS MANAGEMENT DEPARTMENT, AIR FORCE INSTITUTE OF TECHNOLOGY, FOR USE IN A COURSE TITLED "FEDERAL GOVERNMENT FINANCIAL MANAGEMENT."

MY INTEREST IN THE FORCE ANALYSIS PROBLEM DEVELOPED IN THE FALL OF 1970 WHILE TAKING THE ABOVE MENTIONED COURSE. AT THAT TIME ALL COMPUTATIONS ON THE ORIGINAL PROBLEM WERE BEING PERFORMED MANUALLY AND STUDENTS WERE STALLED IN MECHANICS RATHER THAN DEFINING PROBLEMS AND SEARCHING FOR INNOVATIVE SOLUTIONS. INITIALLY MY EFFORT WAS DIRECTED AT COMPUTERIZING THE ORIGINAL PROBLEM. HOWEVER, IT BECAME APPARENT THAT BY MODIFYING THE PROBLEM AND SCENARIO SOMEWHAT AND THEN DEVELOPING A SERIES OF COMPUTER PROGRAMS TO ELIMINATE MANY MATHEMATICAL COMPUTATIONS, THE LEARNING OUTCOMES COULD BE SIGNIFICANTLY EXPANDED IN QUANTITY AND CONTENT. THE RESULTING PACKAGE (SCENARIO, TASKS, AND COMPUTER PROGRAMS) WAS GIVEN THE NAME FORSTRAN, AN ACRONYM FOR FORCE STRUCTURE ANALYSIS.

THIS THESIS WAS PRODUCED USING THE GENERAL ELECTRIC REMOTE

ACCESS EDITING SYSTEM (RAES). RAES IS A TIME-SHARED STORAGE AND RETRIEVAL SYSTEM WITH TEXT-EDITING AND MANUSCRIPT FORMATTING CAPABILITIES. THE CONTENTS OF THE THESIS WERE ENTERED INTO RAES FROM A REMOTE TERMINAL TELETYPE AND EDITED USING THE 'EDITOR' SUBSYSTEM AND THEN FORMATTED FOR TELETYPE OUTPUT IN THE 'RUNOFF' SUBSYSTEM.

THE AUTHOR IS INDEBTED TO THE THOUGHTS, ASSISTANCE, AND INSPIRATION OF MANY PEOPLE: LT. COL. CHARLES J. DORYLAND FOR HIS SUPERB GUIDANCE AND ENCOURAGEMENT IN THIS RESEARCH, DR. HERMANN ENZER FOR HIS HELPFUL SUGGESTIONS, MISS BARB WHELAN OF THE CREATE SOFTWARE STAFF FOR HER EFFORTS IN DEBUGGING COMPUTER SOFTWARE, AND MANY OTHERS. A SPECIAL NOTE OF THANKS TO MY WIFE, LORI, AND FAMILY FOR CHEERFULLY TOLERATING ME DURING THIS PERIOD OF TIME. OF COURSE, THE RESPONSIBILITY FOR THE CONTENT AND CONCLUSIONS IS SOLELY MINE AND DOES NOT IN ANY WAY REFLECT THE VIEWS OF THE DEPARTMENT OF DEFENSE OR, IN PARTICULAR, THE AIR FORCE INSTITUTE OF TECHNOLOGY.

DAVID K. STUBBS

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ABSTRACT

THERE HAS BEEN CONSIDERABLE EMPHASIS RECENTLY ON ANALYSIS (SYSTEMS, ECONOMIC, COST-BENEFIT, ETC.) IN GOVERNMENT DECISIONMAKING ACTIVITIES. ONE APPROACH WHICH IS CURRENTLY POPULAR IS THE PLANNING - PROGRAMMING - BUDGETING SYSTEM (PPBS). PPBS IS OFTEN DESCRIBED AS A MEANS OF HELPING RESPONSIBLE OFFICIALS MAKE DECISIONS. THE IMPLICATION OF THE SYSTEM IS THAT IT INTERRELATES THE PLANNING, BUDGETING, AND DECISIONMAKING FUNCTIONS.

REGARDLESS OF THE NAME OF THE SYSTEM PRESENTLY IN USE, THE RELATIONSHIPS AMONG THESE THREE MANAGEMENT ACTIVITIES IS OF PRIMARY IMPORTANCE. THIS PAPER DEVELOPS A METHODOLOGY TO AID THE EDUCATIONAL PROCESS OF FUTURE DECISIONMAKERS IN THEIR EFFORTS TO INTEGRATE QUANTITATIVE AND NON-QUANTITATIVE ASPECTS BEARING ON PLANNING, BUDGETING, AND DECISION PROBLEMS.

THE FINAL PRODUCT IS A CASE STUDY IN FORCE STRUCTURE ANALYSIS (FORSTRAN). PARTICIPANTS ARE REQUIRED TO DEFINE THE STATUS OF THE CURRENT STRATEGIC RETALIATORY FORCES AS DESCRIBED IN A SCENARIO AND THEN MAKE DECISIONS AS TO FUTURE REQUIREMENTS AND METHODS OF ACHIEVING THOSE REQUIREMENTS. A SET OF COMPUTER PROGRAMS IS FURNISHED TO REMOVE THE NECESSITY OF ROUTINE MATHEMATICAL COMPUTATION AND FREE THE STUDENT TO MORE THOROUGHLY CONSIDER THE NON-QUANTITATIVE ASPECTS OF THE PROBLEM. THE CASE IS AN EXERCISE IN PROBLEM-FINDING AS WELL AS PROBLEM-SOLVING.

THE REPORT CONCLUDES THAT FORSTRAN DOES PROVIDE A VIABLE METHODOLOGY FOR TEACHING FUTURE DECISIONMAKERS ABOUT THE RELATIONSHIPS DEVELOPED AMONG GOVERNMENTAL PLANNING, BUDGETING, AND DECISION PROCESSES. THE CASE STUDY METHOD OF PRESENTATION IS RECOMMENDED FOR CLASSROOM USE OF THIS PROBLEM. SUGGESTIONS FOR FURTHER RESEARCH ARE ALSO OFFERED.

CHAPTER I

BACKGROUND DEVELOPMENT FOR FORSTRAN

"THE LESSON OF HISTORY IS CLEAR - NEITHER COST NOR EFFECTIVENESS ALONE IS A SUFFICIENT BASIS UPON WHICH TO CHOOSE A WEAPON SYSTEM. BOTH MUST BE CONSIDERED SIMULTANEOUSLY AND IN RELATION TO EACH OTHER."

- CHARLES J. HITCH

OUR SOCIETY RECENTLY HAS BEEN CHARACTERIZED BY AN INCREASING QUANTITY AND VARIETY OF GOVERNMENTAL ACTIVITIES. EMPHASIS HAS BEEN PLACED IN SUCH AREAS AS NATIONAL SECURITY, PUBLIC WELFARE, AND ECONOMIC DEVELOPMENT. GOVERNMENT, BEING A NON-PROFIT INSTITUTION, OFTEN HAS DIFFICULTY IN PLANNING AND CONTROLLING THE USE OF PUBLIC RESOURCES. THIS OFTEN REFLECTS GENERAL DISAGREEMENT OR MISUNDERSTANDING OF OBJECTIVES AND PURPOSES OF GOVERNMENTAL ACTIVITIES AND OPERATIONS.

PROBABLY THE MOST SIGNIFICANT PROBLEM FACED BY ANY GOVERNMENTAL UNIT IS THE DIFFICULT AND COMPLEX TASK OF RESOURCE ALLOCATION (*) AND THE FUTURE PLANNING DECISIONS RELATED TO ALLOCATION. MODERN GOVERNMENTS HAVE TO DEVOTE

(*) SPECIFIC DEFINITIONS OF TECHNICAL TERMS, SUCH AS RESOURCE ALLOCATION, FORCE STRUCTURE ANALYSIS, SYSTEMS ANALYSIS, ETC., MAY BE FOUND IN TWO EXCELLENT REFERENCES: THE GAO GLOSSARY (20) AND U. S. ARMY PAMPHLET, AMCP 706-191 (18).

CONSIDERABLE TIME AND EFFORT TO PLANNING FOR THE FUTURE. INEVITABLY, SINCE RESOURCES ARE LIMITED, THE CENTRAL ISSUES IN MOST PLANNING PROBLEMS CONCERN RESOURCE ALLOCATION DECISIONS. (2:1) FISHER HAS POINTED OUT THAT "THERE IS WIDESPREAD AND JUSTIFIABLE INTEREST IN DEVELOPING IMPROVED APPROACHES TO HANDLING RESOURCE ALLOCATION PROBLEMS ASSOCIATED WITH MAJOR PROGRAM DECISIONMAKING PROCESSES IN THE CONTEXT OF LONG-RANGE PLANNING." (2:3)

DURING THE PAST TWO DECADES SEVERAL DISCIPLINES HAVE EMERGED (SYSTEMS ANALYSIS, COST-EFFECTIVENESS ANALYSIS, PROGRAM BUDGETING, AND OPERATIONS RESEARCH TO NAME BUT A FEW), WHOSE PRIMARY INTENT IS TO DEVELOP A SYSTEMATIC APPROACH TO PROBLEM-SOLVING OR DECISIONMAKING THAT DEVELOPS AND COMPARES ALTERNATE MEANS OF ATTAINING A SPECIFIC GOAL OR OBJECTIVE. DECISIONMAKERS WHO USE THESE METHODS ARE CONCERNED WITH OBTAINING AS MUCH OBJECTIVE, QUANTIFIED DATA AS POSSIBLE TO SUPPLEMENT THEIR EXPERIENCE AND INTUITION DURING THEIR DECISIONMAKING PROCESS. THE VALUES OF OBJECTIVE ANALYSIS TO AID DECISIONMAKING HAVE BEEN RECOGNIZED AND EXPOUNDED BY SEVERAL EXPERTS RESULTING IN THE INCORPORATION OF THESE CONCEPTS IN MOST GOVERNMENTAL ACTIVITIES AND MANY PRIVATE BUSINESSES. (2,4,5,9,10,11,16)

PROBLEM

THE BASIC PROBLEM AREA WHICH PROMPTS THIS WORK IS THE INCREASING DEMAND FOR THE EFFICIENT ALLOCATION OF LIMITED

RESOURCES WITHIN THE FEDERAL GOVERNMENT. IN PARTICULAR, WITHIN THE DEPARTMENT OF DEFENSE (DOD) THE ALLOCATION PROBLEM IS PARAMOUNT BECAUSE THE REAL COST TO SOCIETY OF ALLOCATING PRODUCTIVE RESOURCES TO MILITARY PROGRAMS IS THE UNAVAILABILITY OF THESE RESOURCES FOR OTHER PURPOSES. THE CURRENT SHIFT IN PRIORITIES FROM THE MILITARY TO DOMESTIC SECTORS OF THE ECONOMY HIGHLIGHT A DILEMMA IN DOD: PROVIDING MAXIMUM DEFENSE CAPABILITY ON A FIXED BUDGET (OR EQUIVALENTLY, DEVELOPING THE SMALLEST BUDGET POSSIBLE TO PROVIDE FIXED DEFENSE CAPABILITY).

ONE AREA OF MAJOR SIGNIFICANCE WHICH IS RELATED CLOSELY TO THE RESOURCE PROBLEM IS THE DEVELOPMENT AND EVALUATION OF ALTERNATIVES IN CREATING A MILITARY FORCE POSTURE OR STRUCTURE. THE DETERMINATION OF A FORCE POSTURE ESSENTIALLY FIXES THE DEMANDS MADE BY THE MILITARY UPON THE NATION'S PHYSICAL AND MANPOWER RESOURCES.

CONSIDER AS A SPECIAL CASE OF THE TOTAL RESOURCE ALLOCATION PROBLEM THE PROBLEM OF DETERMINING THE VARIOUS MILITARY WEAPON SYSTEMS WHICH WILL COMPOSE THE FUTURE DEFENSE INVENTORY, SAY IN 5, 10, OR MORE YEARS FROM THE CURRENT PLANNING EFFORTS. CONSIDERABLE WORK HAS BEEN DONE UNDER THE HEADING "FORCE STRUCTURE ANALYSIS." HOWEVER, THIS EFFORT HAS BEEN DIRECTED PRIMARILY AT SPECIALIZED STUDIES OF PARTICULAR FORCE STRUCTURES. VERY LITTLE IS AVAILABLE TO HELP FAMILIARIZE STUDENTS OF GOVERNMENT PLANNING AND BUDGETING WITH THE RELEVANT ISSUES THAT MUST BE ANALYZED BY THE

DECISIONMAKER.

THERE ARE PRIMARILY THREE AREAS TO BE CONSIDERED IN FORCE ANALYSIS PROBLEMS: DEVELOPING AND EVALUATING FORCE STRUCTURE ALTERNATIVES, ESTIMATING COST, AND ESTIMATING EFFECTIVENESS. THE PROBLEM OF ESTIMATING COSTS HAS ATTRACTED CONSIDERABLE ATTENTION IN RECENT YEARS. MUCH EFFORT HAS BEEN EXPENDED IN DEVELOPING COST ESTIMATING METHODOLOGY. OBVIOUSLY, ERRORS IN THE ESTIMATES OF COSTS RESULT IN AN INEFFICIENT ALLOCATION OF RESOURCES AND MAY POSSIBLY LEAD TO THE WRONG DECISION AMONG VARIOUS ALTERNATIVES. THE ESTIMATION OF EFFECTIVENESS HAS BEEN APPROACHED BY WAR-GAMING AND SIMULATION TECHNIQUES. SINCE EFFECTIVENESS MAY BE CONSIDERED THE OUTPUT OF A WEAPON SYSTEM, THE IMPACT OF DOD DIRECTIVE 7000.4, OUTPUT MEASUREMENT SYSTEMS, SHOULD BRING MORE EMPHASIS IN THIS AREA. THE OTHER PROBLEM, THAT OF DEVELOPING AND EVALUATING ALTERNATIVES, HAS RECEIVED LITTLE ATTENTION AND WILL BE A MAIN FOCUS OF THIS WORK.

OBJECTIVE

THIS THESIS EFFORT WILL ATTEMPT TO DEVELOP A METHODOLOGY TO AID THE EDUCATIONAL PROCESS OF FUTURE MANAGERS OR DECISIONMAKERS IN THEIR EFFORTS TO INTEGRATE QUANTITATIVE AND NON-QUANTITATIVE ASPECTS BEARING ON THEIR DECISIONS. THE MAJOR EMPHASIS WILL BE ON DEFINITION OF PROBLEMS AND THEN THE DEVELOPMENT AND EVALUATION OF ALTERNATIVE SOLUTIONS TO THOSE PROBLEMS.

METHODOLOGY

AN INDIRECT APPROACH WILL BE TAKEN TO THE GENERAL RESOURCE ALLOCATION PROBLEM. A MODEL WILL BE DEVELOPED USING MILITARY FORCE STRUCTURE ANALYSIS AS A SPECIAL CASE OF RESOURCE ALLOCATION. THE SPECIFIC REASONING AND CONCEPTS THAT MUST BE APPLIED TO SOLVING THE FORCE STRUCTURE PROBLEM REPRESENT SPECIFIC ADAPTATIONS OF GENERAL CONCEPTS WHICH ARE APPLICABLE TO ANY GENERAL RESOURCE ALLOCATION PROBLEM.

TO ACCOMPLISH THE OBJECTIVE OF THIS RESEARCH, A CASE STUDY (*) WILL BE DEVELOPED. THE TITLE, FORSTRAN, IS AN ACRONYM DERIVED FROM THE SUBJECT: FORCE STRUCTURE ANALYSIS. FORSTRAN WILL BE USED TO CONVEY TO PARTICIPANTS SEVERAL LEARNING OBJECTIVES, WHICH ARE DISCUSSED BELOW.

THE DETERMINATION OF THE EFFECTIVENESS, OR SUCCESS, OF FORSTRAN AS AN EDUCATIONAL AID WILL BE BASED ON THE EXTENT TO WHICH THE PARTICIPANTS ACHIEVE THE DESIRED LEARNING OBJECTIVES. OF COURSE, DIFFICULTY IS ENCOUNTERED IN MEASURING ATTAINMENT OF THE LEARNING OBJECTIVES EXCEPT IN A MOST GENERAL, SUBJECTIVE WAY. IT WILL BE ASSUMED THAT THE OVER-ALL EFFORT IS SUCCESSFUL IF THE THREE GENERAL LEARNING OBJECTIVES, DISCUSSED ON PAGE SIX, ARE ACHIEVED. THESE

(*) CASE STUDY, AS USED HERE, REFERS TO A RECORD OF ACTUAL OR HYPOTHETICAL DECISIONMAKING SITUATIONS WHICH INCLUDE ALL THE INFORMATION AVAILABLE AND PERTINENT AT THE TIME THAT A DECISION MUST BE MADE AND A PLAN OF ACTION MUST BE FORMULATED. THE PURPOSE IS TO PROVIDE STUDENTS WITH FACTUAL INFORMATION SO THAT THEY MAY ANALYZE THE SITUATION, DEFINE THE PROBLEMS INVOLVED, AND REACH CONCLUSIONS IN SITUATIONS APPROXIMATING REALITY.

OBJECTIVES WILL BE CONSIDERED ACHIEVED IF A MAJORITY OF THE SPECIFIC LEARNING OUTCOMES DISCUSSED ON PAGES SEVEN THROUGH TEN ARE EXPLICITLY EVALUATED BY THE PARTICIPANTS IN THE EXERCISE.

LEARNING OBJECTIVES FOR FORSTRAN

THE PRIMARY LEARNING OBJECTIVES OF THE METHODOLOGY WE SEEK TO DEVELOP SHOULD BE AIMED AT THE EXPLICIT RECOGNITION AND CONSIDERATION OF FACTORS SUCH AS THOSE DISCUSSED IN THE FOLLOWING PARAGRAPHS.

SIGNIFICANT INTERESTS IN TEACHING GOVERNMENTAL PLANNING, BUDGETING, AND DECISIONMAKING PROCESSES LIE IN THREE BROAD AREAS. THE FIRST IS TO DEVELOP FOR STUDENTS A FAMILIARIZATION WITH NON-QUANTITATIVE ASPECTS OF MILITARY DECISION PROBLEMS, INCLUDING FINDING AND DEFINING THOSE PROBLEMS. SECOND, IT IS DESIRED TO INTRODUCE STUDENTS TO METHODS OF ANALYSIS OF BOTH THE QUANTITATIVE AND THE NON-QUANTITATIVE ASPECTS OF DECISIONMAKING. THE THIRD AREA IS STUDENT FAMILIARIZATION WITH THE USE OF COMPUTER APPLICATIONS TO SUPPORT THE ANALYSIS OF DECISIONMAKING PROBLEMS. WE WILL EXPLORE EACH OF THESE AREAS IN GREATER DETAIL.

FOR YEARS DEFENSE OFFICIALS HAVE BEEN TRANSLATING AMERICAN NATIONAL SECURITY OBJECTIVES AND COMMITMENTS INTO FORCE STRUCTURE AND WEAPONS REQUIREMENTS BASED ON THEIR PERCEPTIONS OF OBJECTIVES AND THEIR ASSESSMENT OF THE

CAPABILITIES OF POTENTIAL ENEMIES. THIS APPROACH NATURALLY LEADS INTO THE DESCRIPTION OF MANY NON-QUANTITATIVE FACTORS AFFECTING MILITARY DECISIONMAKING.

BEFORE ATTEMPTING TO FIND A SOLUTION TO A PROBLEM, A DECISIONMAKER SHOULD ASCERTAIN THAT A PROBLEM ACTUALLY EXISTS. A CONSIDERABLE EFFORT IS OFTEN REQUIRED TO ENSURE THE PROPER DEFINITION OF A PROBLEM ONCE IT HAS BEEN FOUND TO EXIST. (11:35-37,419)

IT IS EXTREMELY IMPORTANT FOR SOMEONE TRYING TO MAKE A DECISION ON A NEW FORCE STRUCTURE TO RECOGNIZE THE EFFECT OF PAST DECISIONS AND COMMITMENTS ON THE AVAILABILITY OF NEW ALTERNATIVES. PAST DECISIONS TO SOME EXTENT HAVE DETERMINED THE PRESENT COURSE OF ACTION BY MAKING BUDGET DEMANDS AND COMMITMENTS, INTERNATIONAL TREATY AND ECONOMIC COMMITMENTS, AND POLITICAL PROMISES. (6:4-5) ONE OF THE THINGS A DECISIONMAKER SHOULD DO IN DEFINING HIS PROBLEM IS DETERMINE HOW RIGID PAST CONSTRAINTS ARE AND WHICH CONSTRAINTS CAN BE ALTERED PRACTICABLY.

AFTER ANALYZING THE CURRENT SITUATION, IT IS THEN ADVISABLE TO CONSIDER WHAT TYPE OF COMMITMENTS FOR THE FUTURE WILL BE INVOLVED IN THE CURRENT DECISION PROCESS. FOR EXAMPLE, IT IS DESIRABLE FOR THE DECISIONMAKER TO PRESERVE FUTURE MILITARY OPTIONS AS BEST HE CAN. (6:1-2,19,23) AGAIN IT IS HELPFUL TO EVALUATE THE TYPES OF ECONOMIC (ESPECIALLY BUDGET), POLITICAL, AND SOCIAL ACTIONS THAT WILL BE INVOLVED IN MAKING A DECISION.

IT IS DESIRABLE TO LOOK AT THESE PROBLEMS FROM VARYING POINTS OF VIEW. FOR EXAMPLE, SHORT-TERM VERSUS LONG-TERM FACTORS OUGHT TO BE CONSIDERED. DIFFERENCES IN IMPACTS ON TOTAL SYSTEM (DOD) AS COMPARED TO SINGLE ORGANIZATIONS (USAF) OR FUNCTIONAL ACTIVITIES (SUPPLY, OPERATIONS, ETC.) SHOULD BE EXAMINED WITH GREAT CARE TO ACHIEVE TEMPORAL AND PHYSICAL BALANCE.

ALSO TO BE CONSIDERED IS THE RELATIONSHIP BETWEEN THE DECISIONMAKER AND THE PERSON DOING THE ANALYSIS OF THE PROBLEM (THE ANALYST). THE VIEWPOINTS OF THESE TWO PARTIES CAN VARY WIDELY IN BOTH THE NATURE OF THE PROBLEM AND THE FORM THAT A SOLUTION WILL TAKE. THE DECISIONMAKER IS RESPONSIBLE FOR PROVIDING GUIDANCE TO THE ANALYST WHICH WILL ENABLE THE ANALYST TO DEFINE THE PROBLEM INVOLVED AND SYNTHESIZE APPROPRIATE ALTERNATIVE SOLUTIONS. THE ANALYST IS RESPONSIBLE FOR PROVIDING TO THE DECISIONMAKER ALL APPROPRIATE INFORMATION USED, SUCH AS ASSUMPTIONS MADE, ADVANTAGES AND DISADVANTAGES OF ALTERNATIVES PRESENTED, ETC.

EXPLICIT RECOGNITION OF RISK AND UNCERTAINTY IN ACHIEVING ANY OF THE DESIRED RESULTS OF THE DECISIONS TO BE MADE IS ALSO A CRITICAL ISSUE. (10:15-17,321) , (2:11) ANALYSTS OUGHT TO DO EVERYTHING POSSIBLE TO IDENTIFY MAJOR AREAS OF UNCERTAINTY AND TO SHOW CLEARLY THEIR IMPLICATIONS FOR THE VARIOUS ALTERNATIVES UNDER CONSIDERATION. UNCERTAINTY, PERHAPS MORE THAN ANYTHING ELSE, TENDS TO COMPOUND THE SEVERITY OF THE PROBLEMS FACED IN THE MILITARY ENVIRONMENT.

(2:202)

IN DISCUSSING THE MILITARY DECISION PROBLEMS, IT IS HELPFUL TO PLACE THE ANALYSIS IN THE FRAMEWORK OF THE CURRENT ENVIRONMENT. FOR EXAMPLE, THE PLANNING - PROGRAMMING - BUDGETING SYSTEM (PPBS) PROVIDES AN INITIAL BASIS FOR PROGRAM STRUCTURES AND COST BREAKDOWNS. THE PPB SYSTEM REQUIRES DETERMINATION AND EVALUATION OF PROGRAM OBJECTIVES, MEASUREMENT OF TOTAL COSTS OVER A SEVERAL YEAR PERIOD, AND ANALYZING OF ALTERNATIVES TO MEET OBJECTIVES. (3:2-3)

ONE FURTHER CONSIDERATION IN NON-QUANTITATIVE FACTORS IS THE DESIRABILITY AND USEFULNESS OF AN OUTPUT MEASURE. DOD DIRECTIVE 7000.4 DESCRIBES THE USE OF OUTPUT MEASUREMENT SYSTEMS WITHIN DOD. THESE SYSTEMS ARE INTENDED TO IMPROVE DESCRIPTION OF THE OUTPUT OF ORGANIZATIONS AND THE USE OF OUTPUT MEASURES TO SUPPORT DECISIONMAKING. (19) WHILE THIS MAY APPEAR HIGHLY DESIRABLE, THERE ARE ALSO MANY PITFALLS AND LIMITATIONS IN THE INDISCRIMINATE USE OF QUANTITATIVE OUTPUT MEASURES.

ONCE THE NON-QUANTITATIVE FACTORS HAVE BEEN IDENTIFIED AND EXPLICITLY EVALUATED, THEN DECISIONMAKERS FREQUENTLY COMBINE THEM WITH QUANTITATIVE FACTORS INTO SOME TYPE OF METHODOLOGY FOR TOTAL ANALYSIS OF THE DECISIONMAKING PROBLEM. OF PRIMARY CONCERN HERE IS THE RECOGNITION OF THE COMPLEXITY OF THE DECISIONS INVOLVED. IN ORDER TO PERFORM AN ANALYSIS, A SET OF CRITERIA ARE USUALLY ESTABLISHED TO MEASURE THE RELATIVE VALUE OR DESIRABILITY OF ANY SOLUTIONS WHICH MAY BE

PROPOSED. CRITERIA ARE ESTABLISHED IN RELATION TO GUIDANCE ISSUED BY SOME HIGHER AUTHORITY. USUALLY THIS GUIDANCE IS INSUFFICIENT TO ADEQUATELY DEFINE A SET OF CRITERIA. INSUFFICIENCY MAY BE CAUSED BY A LACK OF UNDERSTANDING OF THE PROBLEM OR OF THE OBJECTIVES OR OF THE ANALYSIS METHODOLOGY.

ONCE THE CRITERIA HAVE BEEN ESTABLISHED, THEN A COMPLETE EVALUTATION OF ALL RELEVANT QUANTITATIVE AND NON-QUANTITATIVE FACTORS MAY BE UNDERTAKEN. THIS USUALLY LEADS TO SEVERAL FEASIBLE SOLUTIONS OR ALTERNATIVES WHICH MAY BE ADOPTED BY THE DECISIONMAKER. ONE OF THE GOALS OF AN ANALYSIS METHODOLOGY SHOULD BE TO DEVELOP A WIDE VARIETY OF ALTERNATIVES TO HELP MAKE THE DECISIONMAKER AWARE OF THE MANY DIFFERENT COURSES OF ACTION HE MAY UNDERTAKE AND THE UNIQUE ADVANTAGES AND DISADVANTAGES OF EACH.

NOT UNTIL AN ANALYSIS METHODOLOGY HAS BEEN CLEARLY DEFINED IS THE UTILIZATION OF A COMPUTER ADVANTAGEOUS OR DESIRABLE. A COMPUTER CAN HELP ONLY WITH PROBLEMS THAT THE ANALYST KNOWS CONCEPTUALLY HOW TO SOLVE BY HIMSELF. (11:421) HOWEVER, ONCE AN APPROACH IS DETERMINED, A COMPUTER CAN ASSIST IN PROVIDING MANY INSIGHTS INTO THE AVAILABILITY AND DESIRABILITY OF ALTERNATIVES BY PERFORMING ROUTINE COMPUTATIONS AND COMPARISONS DEALING WITH QUANTIFIABLE CRITERIA.

CERTAIN ADVANTAGES ARE DERIVED FROM INTERACTIVE TIME-SHARING COMPUTER OPERATIONS. PARTIALLY OFF-SETTING ANY ADVANTAGES,

HOWEVER, ARE ACCOMPANYING DISADVANTAGES. IT SEEMS HIGHLY DESIRABLE FOR THE STUDENT TO HAVE SOME PRACTICAL KNOWLEDGE OF THESE ADVANTAGES AND DISADVANTAGES BEFORE BEING FACED WITH COMPUTER USE IN HIS FUTURE JOB.

IT IS RECOGNIZED THAT THE GOVERNMENT DECISIONMAKER MUST BE WILLING TO GO JUST AS FAR AS THE AVAILABLE FACTS AND GUIDANCE WILL LEAD AND THEN GO ON INTO THE UNKNOWN WHERE THERE ARE NO RIGHT OR WRONG ANSWERS. HE MUST USE JUDGMENT, INTUITION, AND EXPERIENCE IN MAKING DECISIONS ABOUT FUTURE EVENTS, ESPECIALLY EVENTS WITH THE INHERENT UNCERTAINTY OF THE DEFENSE ENVIRONMENT. A PURPOSE OF DEVELOPING FORSTRAN IS TO INTRODUCE THE STUDENT DECISIONMAKER INTO THE "REAL WORLD," AND SHOW HIM THAT ANALYSIS OF ALL RELEVANT FACTORS, BOTH QUANTITATIVE AND NON-QUANTITATIVE, IS ESSENTIAL. BUT IT ALSO IS INTENDED TO SHOW HIM THAT ANALYSIS IS LIMITED TO INCREASING ONE'S AWARENESS OF THE COMPLEXITIES AND INTERRELATIONSHIPS THAT ARE INVOLVED.

FORSTRAN IS DESIGNED TO PERMIT FUTURE DECISIONMAKERS TO CONSIDER THE RELATIONSHIPS BETWEEN LONG-RANGE PLANNING, GOVERNMENTAL BUDGETING, AND RELATED DECISIONMAKING PROCESSES. PARTICIPANTS IN THIS CASE STUDY HAVE AN OPPORTUNITY TO EXPLORE THE IMPACT OF PAST AND CURRENT DECISIONS REGARDING EXPENDITURES AND COMMITMENTS ON FUTURE PLANNING AND BUDGETING. THEY ALSO HAVE THE OPPORTUNITY TO EXPERIENCE THE DEMANDS MADE ON DECISIONMAKERS TO DEFINE PROBLEMS, CHOOSE OBJECTIVES, FORMULATE AND EVALUATE

ALTERNATIVES, AND MAKE A DECISION. IT IS HOPED THAT THE CONCEPTS AND EXPERIENCE ACQUIRED IN THIS EXERCISE CAN THEN BE EXTENDED TO OTHER SIMILAR CIRCUMSTANCES WHICH THE PARTICIPANT WILL FACE IN HIS FUTURE CAREER.

CHAPTER II

DEVELOPMENT OF FORSTRAN

"NO COMPUTER WILL AUTOMATICALLY PROVIDE THE ANSWER, ALTHOUGH A CAREFULLY FORMULATED COMPUTER PROGRAM CAN, UNDER SPECIFIED CONDITIONS, GIVE VALUABLE INSIGHTS...."

- CHARLES J. HITCH

OBSERVATION OF THE MODERN POLITICAL, SOCIAL, AND ECONOMIC ISSUES FREQUENTLY INDICATES THAT THERE IS SELDOM A UNIQUE, ABSOLUTE, CORRECT SOLUTION TO ANY QUESTION POSED IN THE GOVERNMENTAL DECISIONMAKING ENVIRONMENT. FORCE STRUCTURE ANALYSIS IS CLEARLY SUCH A NON-DETERMINISTIC INQUIRY. THE EDUCATION PROFESSION HAS RECOGNIZED THAT A HIGHLY EFFECTIVE METHOD OF PREPARING INDIVIDUALS TO THINK AND ACT IN THE PRESENCE OF NEW SITUATIONS IS TO PRESENT THEM WITH ANALOGUES OF EXACTLY THE KINDS OF PROBLEMS THAT WILL BE CONFRONTING THEM AFTER THEY LEAVE THE EDUCATIONAL ENVIRONMENT. THIS RESEARCH WILL DEVELOP SUCH AN ANALOGUE IN THE FORM OF A CASE STUDY CALLED FORSTRAN, WHICH IS PRESENTED IN APPENDIX A. IT USES FORCE STRUCTURE ANALYSIS TO CONVEY THE DECISIONMAKING ENVIRONMENT TO THE STUDENT.

THIS CHAPTER IS DEVOTED TO A DESCRIPTION OF THE SCENARIO TO BE DEVELOPED, THE DECISIONMAKING PROBLEMS WHICH WILL BE PRESENTED TO THE STUDENTS, AND THE COMPUTER PROGRAMS TO BE

WRITTEN TO AID IN THE DECISION PROCESS. THEN A DISCUSSION OF THE PRESENTATION OF THE CASE TO A CLASS OF FUTURE DECISIONMAKERS AND THE EXPECTED CLASS RESPONSE TO THE TASKS IS EXPLAINED.

SCENARIO

A SCENARIO WILL BE DEVELOPED BASED ON A SIMILAR SCENARIO CREATED IN THE ORIGINAL EXERCISE. IT WILL DESCRIBE THE EXISTING AND PROJECTED POLITICAL, SOCIAL, AND ECONOMIC CLIMATE. A DESCRIPTION OF A PRESENT FORCE POSTURE WILL BE PROVIDED, ALONG WITH ALTERNATIVES FOR ADJUSTING THE WEAPON SYSTEM COMBINATIONS CURRENTLY AVAILABLE. TWO NEW WEAPON SYSTEMS WILL BE INTRODUCED FOR ANALYSIS THROUGH THE PHASES OF RESEARCH AND DEVELOPMENT, INVESTMENT, AND OPERATIONS. COST DATA WILL BE PROVIDED AS DATA INPUT OF A COST ANALYSIS TEAM. A QUANTITATIVE MEASURE OF EFFECTIVENESS WILL BE PRESENTED TO FACILITATE COMPARABILITY OF SYSTEMS. ALTHOUGH A QUANTITATIVE MEASURE OF EFFECTIVENESS MAY SEEM ARTIFICIAL SINCE ONE DOES NOT CURRENTLY EXIST, THE INTRODUCTION OF SUCH A MEASURE WILL PERMIT ATTENTION TO BE FOCUSED ON THE OTHER NON-QUANTIFIABLE POLITICAL, SOCIAL, AND ECONOMIC PROBLEMS FACING THE DECISIONMAKER. OFTEN THESE OTHER ISSUES ARE IGNORED OR LOST DUE TO EXTENSIVE SEMANTIC DEBATES ON MATTERS OF "EFFECTIVENESS." IT ALSO OPENS THE POSSIBILITY FOR DISCUSSION AND EVALUATION OF THE DESIRABILITY AND USEFULNESS OF QUANTITATIVE OUTPUT MEASURES. THE SCENARIO, AS USED IN THIS RESEARCH, IS PRESENTED IN APPENDIX A.

THE TASKS

THE DECISIONMAKING PROCESS WILL BE APPROACHED IN THREE PHASES. FIRST, THE CONSIDERATIONS OF A RESEARCH AND DEVELOPMENT PLANNER WILL BE EXPLORED. THIS WILL BE A RATHER SIMPLE COMPUTATIONAL TASK TO INTRODUCE THE STUDENTS TO THE SCENARIO AND THE USE OF THE COMPUTER. IT WILL GIVE A FUNCTIONAL VIEW TO THE VARIOUS DECISION PROCESSES.

IN THE SECOND TASK, THE FORCE STRUCTURE WILL BE ANALYZED FROM A SHORT-TERM VIEWPOINT. THE EMPHASIS WILL BE PLACED ON DEVELOPING CRITERIA FOR ANALYSIS WHERE THE PRIMARY CONSIDERATION IS DEALING WITH BUDGET CONSTRAINTS.

THE LAST TASK WILL SURVEY A LONG-RANGE VIEW OF THE ENTIRE SYSTEM AS WOULD PROBABLY BE CONSIDERED BY A TOP MANAGEMENT STRATEGIC WEAPONS PLANNING COMMITTEE. IT WILL EMPHASIZE THE TOTAL TEN-YEAR PLANNING CYCLE OF BOTH COST AND EFFECTIVENESS.

THE THREE TASKS, AS PRESENTED TO THE STUDENTS, ARE GIVEN FOLLOWING THE SCENARIO IN APPENDIX A. ALL THREE TASKS ASK THE STUDENT THE SAME FIVE QUESTIONS CONCERNING THE STUDENT'S APPROACH TO SOLVING THE PROBLEMS. THE INTENTION IS TO BE ABLE TO DETERMINE ANY CHANGES IN THE STUDENT'S APPROACH OR WAY OF THINKING AND ANALYZING THE PROBLEMS. FURTHER DISCUSSION OF THIS ASPECT APPEARS LATER IN THIS CHAPTER.

COMPUTER PROGRAMS

AFTER READING THE SCENARIO AND TASKS, IT BECOMES OBVIOUS THAT A PROBLEM OF THIS TYPE COULD EASILY BECOME BOGGED DOWN IN REPETITIOUS MATHEMATICAL COMPUTATIONS OF COST AND EFFECTIVENESS OF VARIOUS FORCE STRUCTURE OPTIONS WHERE THE STUDENT WOULD RAPIDLY LOSE SIGHT OF THE REAL PROBLEMS INVOLVED. THEREFORE, A SET OF COMPUTER PROGRAMS WILL BE DEVELOPED AND PROVIDED TO ACCOMPLISH THE MATHEMATICAL COMPUTATIONS AND FREE THE PARTICIPANTS TO CONSIDER THE NON-MATHEMATICAL ASPECTS OF THE PROBLEM.

TWO PROGRAMS WILL BE ENTIRELY EXPLANATORY IN NATURE. THE FIRST, CALLED 'TEACH', DISCUSSES THE CONTENTS AND UTILIZATION OF ALL PROGRAMS AND DATA FILES DEVELOPED FOR FORSTRAN. THE OTHER, CALLED 'IDENT', PROVIDES CORRESPONDENCE BETWEEN THE NUMERICAL IDENTIFICATION OF FORCE OPTIONS USED BY THE COMPUTER AND THE VERBAL DESCRIPTION USED BY THE STUDENTS.

TWO PROGRAMS WILL BE CONCERNED WITH THE RESEARCH AND DEVELOPMENT TASK (TASK 1). THE PROGRAM 'RDP' COMPUTES THE TEN-YEAR R&D COST AND EFFECTIVENESS VALUES FOR THE SIXTY POSSIBLE COMBINATIONS OF THE CURRENT FORCE OPTIONS. THE OTHER PROGRAM, 'RDF', THEN COMBINES THE RESULTS OF 'RDP' WITH THE R&D COSTS AND EFFECTIVENESS VALUES OF THE PROPOSED NEW SYSTEM TO GIVE A TOTAL NEW FORCE STRUCTURE OPTION.

THE REMAINING TWO PROGRAMS ARE ESSENTIALLY IDENTICAL TO THE

PRECEDING TWO PROGRAMS EXCEPT THAT TOTAL COSTS (RESEARCH AND DEVELOPMENT PLUS INVESTMENT PLUS OPERATIONS) ARE COMPUTED INSTEAD OF ONLY R&D COSTS. THE PROGRAM 'PRES' COMPUTES CURRENT FORCE OPTIONS AND THE PROGRAM 'FORCE' COMPUTES TOTAL (CURRENT PLUS NEW) FORCE OPTIONS.

THERE ARE NINE DATA FILES WHICH ARE USED BY THE PRECEDING SIX PROGRAMS. EFFECTIVENESS VALUES FOR THE CURRENT WEAPON SYSTEMS ARE INPUT FROM THE FILE 'SEFU' (*). R&D COSTS ARE INPUT FROM 'RDC' AND TOTAL COSTS ARE INPUT FROM 'COST'. THE PROGRAMS 'PRES' AND 'RDP' THEN CONVERT THE DATA TO CURRENT FORCE STRUCTURE OPTION DATA. EFFECTIVENESS DATA IS STORED IN 'OLDS', R&D COST DATA IN 'OLDRD', AND TOTAL COST DATA IN 'OLDC'. THESE THREE FILES THEN PROVIDE THE INPUT TO THE PROGRAMS 'FORCE' AND 'RDF'. THE FINAL TOTAL NEW FORCE OPTION DATA IS STORED IN THE FILE 'RDSOLN' FOR R&D COST DATA AND IN THE FILE 'SOLN' FOR TOTAL COST DATA. THE REMAINING DATA FILE IS 'IDOUT' WHICH IS THE OUTPUT FOR THE PROGRAM 'IDENT' (IDENTIFICATION OF CURRENT FORCE OPTIONS).

ALL COMPUTER PROGRAMS ARE PRESENTED IN APPENDIX B. THE DATA FILES ARE GIVEN IN APPENDIX C.

THE I. 'DIATE UTILIZATION OF THIS CASE STUDY WILL BE AS AN INSTRUCTIONAL AID IN THE COURSE "FEDERAL GOVERNMENT FINANCIAL MANAGEMENT" OFFERED AT THE AIR FORCE INSTITUTE OF TECHNOLOGY. THIS COURSE IS OFFERED PRIMARILY TO STUDENTS OF

(*) STRATEGIC EFFECTIVENESS UNIT; SEE PAGE 46.

SYSTEMS MANAGEMENT AND SYSTEMS ANALYSIS TO ACQUAINT THEM WITH FINANCIAL DECISIONMAKING IN THE FEDERAL GOVERNMENT, PARTICULARLY AS APPLICABLE TO RESOURCE ALLOCATION AND FINANCIAL MANAGEMENT.

AN EXERCITATION

THIS CASE STUDY WILL BE ADMINISTERED AS A CLASS ASSIGNMENT TO THE FALL 1971 COURSE IN FEDERAL GOVERNMENT FINANCIAL MANAGEMENT. ON THE BASIS OF THIS VERY LIMITED TEST, THE RESULTS OF THIS EXERCISE WILL BE EVALUATED TO MAKE STATEMENTS ABOUT THE VALUE OF FORSTRAN AS AN EDUCATIONAL DEVICE TO AID IN THE DEVELOPMENT OF DECISIONMAKING CAPABILITIES.

READINGS IN THE FEDERAL GOVERNMENT FINANCIAL MANAGEMENT COURSE ARE BASED ON TEXTS BY BURKHEAD (1), HITCH (4), AND NOVICK (9) WITH SUPPLEMENTAL READINGS FROM STEINER (16) AND OTHERS (7,17). MAJOR TOPICS THAT ARE COVERED INCLUDE LONG-RANGE FINANCIAL PLANNING, CONTROL FUNCTIONS, AIR FORCE BUDGETING PROCEDURES, AND THE PPB SYSTEM. FORSTRAN HAS BEEN DEVELOPED TO INTEGRATE MANY OF THESE TOPICS INTO A PRACTICAL, REAL-LIFE EXAMPLE TO HELP PREPARE THE STUDENTS FOR FINANCIAL MANAGEMENT IN THEIR FUTURE JOBS AS GOVERNMENT DECISIONMAKERS.

IT SHOULD BE POINTED OUT THAT STUDENTS PARTICIPATING IN THIS EXERCISE ARE SCHEDULED TO GRADUATE AT THE CLOSE OF THE FALL TERM. THEY ARE CONCURRENTLY REGISTERED IN THREE OTHER

GRADUATE LEVEL COURSES AND SEVERAL ARE ALSO COMPLETING FINAL WORK ON THESIS REQUIREMENTS. THIS ENVIRONMENT MUST BE KEPT IN MIND WHEN DETERMINING EXPECTED RESPONSES AND EVALUATING STUDENT PERFORMANCE AGAINST EXPECTATIONS. UNFORTUNATELY, STUDENTS IN THIS ENVIRONMENT FREQUENTLY HAVE INSUFFICIENT TIME AND MOTIVATION TO DO AS MUCH AS WOULD BE LIKED BY THEIR INSTRUCTORS. HOWEVER, THIS MAY BE HIGHLY TYPICAL OF THEIR FUTURE DECISIONMAKING ENVIRONMENTS.

EXPECTATIONS

SEVERAL CONSTRAINTS ARE OPERATING IN THE ADMINISTRATION OF THIS TYPE OF A PROJECT TO A CLASS. APART FROM THE TIME CONSTRAINT MENTIONED IN PREVIOUS PARAGRAPHS, ONE MAJOR LIMITATION IS THE FORM OF THE CASE STUDY. BY USING THREE SPECIFIC TASKS, A FRAME OF REFERENCE IS ESTABLISHED BEGINNING WITH A PAROCHIAL, FUNCTIONAL VIEW TO THE BUDGET PROBLEM AND WORKING THROUGH SHORT-TERM VIEWS TO A LONG-RANGE PLANNING VIEWPOINT. THIS NECESSARILY ENCOURAGES STUDENTS TO TAKE A NARROW PERSPECTIVE ON ANY GIVEN PHASE OF THE PROBLEM RATHER THAN TRYING TO SIZE-UP THE WHOLE PROBLEM FROM THE START. THIS MAY BE ADVANTAGEOUS, HOWEVER, AS IT PROBABLY SIMULATES CLOSELY THE PAROCHIAL ENVIRONMENT OF MANY DECISIONMAKING POSITIONS.

ANOTHER PROBLEM ARISES FROM THE DECISION TO ASK THE SAME QUESTIONS OF THE STUDENT IN EACH EXERCISE. THE QUESTIONS ARE QUITE GENERAL IN NATURE WHICH TENDS TO PROMOTE A WIDE

VARIETY OF RESPONSES DEPENDING UPON WHAT EACH STUDENT FELT WERE THE IMPORTANT ISSUES TO BE CONSIDERED. IT BECOMES VIRTUALLY IMPOSSIBLE TO SEEK A SPECIFIC RESPONSE ON THE PART OF EACH STUDENT. THE EFFORT OF EVALUATING STUDENT RESPONSES WITH RESPECT TO THE STATED LEARNING OBJECTIVES THEN BECOMES A MATTER OF SUBJECTIVE JUDGMENT OF THE EVALUATOR. STUDENT A AND STUDENT B MAY ADDRESS TWO ENTIRELY DIFFERENT SETS OF ISSUES, BUT BOTH MAY ACHIEVE THE DESIRED LEARNING EQUALLY.

ADDING TO THE STRUCTURE OF THE PROBLEMS IS THE PRE-PROGRAMMED COMPUTER MODEL, WHICH OF NECESSITY, PLACES STRONG EMPHASIS ON THE QUANTITATIVE ASPECTS OF THE SEFU AND BUDGET. SINCE THIS SERIES OF PROGRAMS IS RATHER INFLEXIBLE IN THE TYPE OF INPUT DEMANDED, IT TENDS TO PUSH STUDENTS IN ONE DIRECTION FORCING THEM TO MAKE A SPECIAL CONSCIOUS EFFORT TO LOOK AT OTHER ASPECTS OF THE PROBLEMS. THIS MAY, OR MAY NOT, BE REPRESENTATIVE OF THE ENVIRONMENT THAT THEY WILL BE ENTERING.

CONSIDERING THE RATHER RIGID STRUCTURE OF THE PROGRESSION THROUGH THREE SEPARATE TASKS, ONE WOULD HOPE THAT THE EXPECTATIONS FOR REALIZATION OF LEARNING OBJECTIVES WOULD PROGRESS DURING THE TIME PERIOD. THAT IS, ONE WOULD EXPECT A TIME-PHASED LEARNING OUTCOME RATHER THAN A SUDDEN, SINGULAR RESPONSE TO THE SOLUTION OF THE PROBLEMS INVOLVED IN THIS CASE STUDY. IT SHOULD BE EXPECTED THAT THE STUDENTS WILL PROGRESS IN THEIR SOPHISTICATION TOWARD FINDING AND SOLVING PROBLEMS AS THEY LEARN FROM THEIR EXPERIENCES IN THE EARLY

EXERCISES AND PROCEDE TO THE LAST EXERCISE.

WHEN EVALUATING STUDENT PERFORMANCE, ONE WOULD LOOK FOR AND EXPECT TO FIND MANY OF THE FOLLOWING ACTIVITIES AND CHANGES IN THE STUDENT RESPONSE TO QUESTIONS POSED:

(1) FIRST, THE STUDENT SHOULD ATTEMPT TO DEFINE THE CURRENT STATUS WITH WHICH HE IS WORKING. AN ATTEMPT SHOULD BE MADE TO ESTABLISH REASONABLE BUDGET AND SEFU VALUES FOR THE CURRENT YEAR BASED UPON THE PROJECTED (CURRENTLY PLANNED) VALUES OF $22.3 BILLION AND 3000, RESPECTIVELY, FOR NEXT YEAR. INITIALLY, THESE MAY BE ASSUMED AS CURRENT VALUES, BUT THE STUDENT SHOULD ATTEMPT TO EVALUATE AND ANALYZE THE RIGIDITY OF THESE VALUES AND THE SIGNIFICANCE OF ANY POSSIBLE CHANGES IN THESE VALUES.

(2) EARLY IN EACH TASK THE STUDENT SHOULD EXPLICITLY DEFINE THE EXTENT AND SIGNIFICANCE OF ANY GUIDANCE WHICH HAS BEEN GIVEN TO THE TASK-FORCE, BOTH FROM THE SCENARIO AND CLASS DISCUSSIONS. GUIDANCE DEVELOPED BY THE DECISIONMAKER AND GIVEN THE ANALYST HAS A DIRECT BEARING ON THE APPROACH TAKEN TO DEFINING AND SOLVING PROBLEMS.

(3) USING THE GUIDANCE, EXPLICIT CRITERIA SHOULD BE DEVELOPED AND EVALUATED. THE CRITERIA ARE USED TO DETERMINE THE EXTENT TO WHICH A PROPOSED SOLUTION SOLVES THE PROBLEM PRESENTED. A DISTINCTION SHOULD BE MADE AMONG CRITERIA AS TO WHETHER THEY ARE QUANTITATIVE OR NON-QUANTITATIVE AND THE IMPORTANCE AND FLEXIBILITY OF EACH.

(4) THE CRITERIA SHOULD REFLECT SEVERAL PROPERTIES WHICH CHANGE FROM TASK 1 TO TASK 3. THE FOLLOWING WOULD BE

EXPECTED:

(A) THE DISTINCTION BETWEEN QUANTITATIVE AND NON-QUANTITATIVE CRITERIA SHOULD BECOME MORE NOTICEABLE.

(B) A SHIFT AWAY FROM QUANTITATIVE CRITERIA TOWARD NON-QUANTITATIVE CRITERIA WILL PROBABLY TAKE PLACE.

(C) AN INCREASE IN THE NUMBER OF CRITERIA CONSIDERED SHOULD OCCUR.

(D) DEFINITION OF CRITERIA SHOULD BECOME LESS RIGID AND MORE CONDITIONAL UPON OTHER CRITERIA AND PARAMETERS, INCLUDING THE GUIDANCE PROVIDED BY THE DECISIONMAKER.

(5) FROM TASK 1 TO TASK 3, THE NUMBER OF FEASIBLE SOLUTIONS DEVELOPED AND CONSIDERED SHOULD INCREASE AS THE CRITERIA UNDERGO THE CHANGES MENTIONED ABOVE.

(6) BY THE SAME TOKEN, THE NUMBER OF SOLUTIONS PRESENTED TO THE DECISIONMAKER (STUDENT ANSWERS) SHOULD BECOME MORE BROAD. THAT IS, MORE ALTERNATIVES SHOULD BECOME FEASIBLE SOLUTIONS TO THE STUDENT AND WORTHY OF RECOMMENDATION TO THE DECISIONMAKER IN AN ATTEMPT TO PROVIDE FLEXIBILITY AND VERSATILITY IN FUTURE FORCE STRUCTURE DECISIONS.

(7) THE STUDENTS SHOULD BE EXPECTED TO MOVE AWAY FROM A PAROCHIAL, FUNCTIONAL APPROACH TO A BROAD OVERALL POINT OF VIEW TOWARD SOLVING THE PROBLEMS. THIS IS PARTLY DUE TO THE SHIFT IN EMPHASIS IN THIS DIRECTION FROM TASK 1 TO TASK 3, BUT ALSO SHOULD BE DUE TO STUDENT RECOGNITION OF IMPLICATIONS OF DECISIONS BEYOND THE PAROCHIAL ENVIRONMENT.

(8) HOPEFULLY, STUDENTS WILL QUESTION THE VALUE, USEFULNESS,

AND VALIDITY OF THE QUANTITATIVE OUTPUT MEASURE, THE SEFU, SINCE IT IS STATED IN THE SCENARIO THAT OTHER FACTORS, SUCH AS THE TRIAD CONCEPT, MAY BE ASSESSED SEPARATELY FROM AND IN ADDITION TO THE SEFU.

(9) THE LIKELIHOOD OF ENTIRELY NEW ALTERNATIVES FOR SOLUTION TO THE PROBLEMS SHOULD INCREASE AS THE STUDENTS PROCEDE THROUGH THE THREE TASKS.

IT IS HOPED THAT BY ASKING FIVE GENERAL QUESTIONS PERTAINING TO DEFINITION OF THE PROBLEM, CRITERIA, RECOMMENDATIONS, AND COMPUTER USAGE IN EACH OF THE THREE TASKS THAT A PROGRESSION OF SOPHISTICATION IN THE SOLUTION OF THE PROBLEMS MIGHT BE RECOGNIZED. ONE MIGHT INTERPRET THIS AS AN EVOLUTION OF UNDERSTANDING AS EXEMPLIFIED IN THE PRECEDING EXPECTATIONS.

THE NEXT CHAPTER PRESENTS THE RESULTS OF THE ADMINISTRATION OF FORSTRAN TO THE FALL 1971 FEDERAL GOVERNMENT FINANCIAL MANAGEMENT CLASS AND AN ANALYSIS OF THESE RESULTS IN RELATION TO THE RESEARCH OBJECTIVES, THE DESIRED LEARNING OBJECTIVES, AND THE EXPECTATIONS WHICH HAVE BEEN PRESENTED ABOVE.

CHAPTER III

UTILIZATION OF FORSTRAN

"THE INVENTION OF NEW ALTERNATIVES CAN BE MUCH MORE VALUABLE THAN THE EXHAUSTIVE COMPARISON OF GIVEN ALTERNATIVES, NONE OF WHICH MAY BE VERY SATISFACTORY."

- E. S. QUADE

SELECTED COMMENTS FROM THE WRITTEN SUMMARIES PRESENTED BY THE STUDENTS PARTICIPATING IN THE FIRST USE OF FORSTRAN ARE COLLECTED IN APPENDIX D. THIS CHAPTER WILL SUMMARIZE THOSE COMMENTS AND OTHER RESULTS AND PRESENT A DISCUSSION OF THOSE RESULTS RELATED TO THE OBJECTIVE OF THIS RESEARCH AND THE ANTICIPATED LEARNING OBJECTIVES.

SUMMARY OF RESULTS

THE STUDENTS BEGAN TASK I BY ASSUMING THAT THE PROBLEM CONFRONTING THEM WAS THAT THE U.S. STRATEGIC RETALIATORY STRENGTH WAS NOT ADEQUATE TO MEET SECURITY NEEDS AND THAT THE OBVIOUS SOLUTION WAS TO RAPIDLY DEVELOP ONE OF THE NEW WEAPON SYSTEMS PRESENTED AS ALTERNATIVES [111,112]. (*) ALTHOUGH THIS VIEW DID NOT CHANGE SIGNIFICANTLY IN TASK 2, IT WAS APPARENT THAT THE STUDENTS BEGAN TO RECOGNIZE THE

(*) NUMBERS IN BRACKETS, [ ] , REFER TO PARAGRAPH NUMBERS OF DATA AS PRESENTED IN APPENDIX D.

LIMITATIONS IMPOSED BY THE CURRENT STRUCTURE [211]. BY TASK 3, THEY HAD DISCOVERED THAT THEIR PROBLEMS INCLUDED NOT ONLY EVALUATING THE CURRENTLY PROPOSED OPTIONS, BUT ALSO DEFINING THE CURRENT BUDGET AND SEFU STATUS, DETERMINING WHAT CHANGES WOULD BE REQUIRED, DEVELOPING NEW ALTERNATIVES BESIDES THOSE GIVEN TO THEM IN THE SCENARIO, EVALUATING CONSTRAINTS PLACED ON THEM BY PAST PLANNERS, AND EVALUATING THE CONSTRAINTS THEY WERE PASSING ON TO FUTURE PLANNERS [311-318].

STUDENT CRITERIA INITIALLY WERE BASED ON THE ASSUMPTION THAT THE CURRENT SEFU WAS 3000 AND THAT AN INCREASE OF ONE-THIRD MUST BE EFFECTED, BRINGING THE SEFU LEVEL UP TO 4000 IN YEAR FIVE [121]. OTHER ARBITRARY CRITERIA, SUCH AS NO NEW R&D EXPENSES IN THE FIRST YEAR, ONLY ONE NEW SYSTEM TO BE DEVELOPED, AND NO CONSIDERATION OF THE B-2, WERE DEVELOPED AND ACCEPTED WITHOUT EVALUATION OF THE EFFECTS ON FUTURE PLANNERS [122-126]. THE PRIMARY EMPHASIS BY THE STUDENTS WAS ON GETTING A CERTAIN SEFU LEVEL REGARDLESS OF COST EXCEPT IN THE CURRENT YEAR. ALTHOUGH THE COMPUTER PROGRAM 'RDF' WAS PROGRAMMED TO PERMIT A TOTAL OF SIXTY-SIX FEASIBLE SOLUTIONS IN TASK 1, NO STUDENTS QUESTIONED THE CRITERIA WHICH WERE ESTABLISHED TO PROVIDE THOSE OPTIONS. TWO SIGNIFICANT CHANGES WERE MADE IN TASK 2: FIRST YEAR R&D WAS PERMITTED SINCE IT WAS RECOGNIZED THAT SOME WORK SHOULD BE DONE REGARDLESS OF ELECTION-YEAR POLITICS [232] AND THE B-2 REPLACED THE SS-1 AS THE DOMINANT ALTERNATIVE SINCE IT WAS DETERMINED (OR ASSUMED) THAT EITHER SYSTEM WOULD FULFILL THE TRIAD CONCEPT BUT THAT THE B-2 COST LESS IN DEVELOPMENT AND

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INVESTMENT AND TOTAL COSTS IN THE TEN-YEAR PLANNING CYCLE.

THE SIGNIFICANT CHANGE RECOGNIZABLE IN TASK 3 CRITERIA WAS THE DEFINITION OF CURRENT STATUS. STUDENTS DETERMINED THAT 3000 SEFU WAS NOT NECESSARILY A VALID STARTING POINT AND DETERMINED THAT A REASONABLE STARTING POINT WAS IN THE RANGE 2100 TO 3000 WHICH IMPLIED A FIFTH YEAR RANGE OF 2800 TO 4000, SINCE THEY ACCEPTED AN INCREASE OF ONE-THIRD OVER THAT TIME PERIOD [321-323]. FURTHERMORE, THE STUDENTS VALUED FUTURE FLEXIBILITY HIGHLY AND EXPLICITLY EVALUATED CRITERIA IN THEIR EFFECT ON FUTURE PLANNING [324,333].

RECOMMENDATIONS PRESENTED BY THE STUDENTS BEGAN WITH A STRICT ONE SYSTEM DEVELOPMENT OVER ONE TIME FRAME IN TASK 1. NO ALTERNATIVES WERE DEVELOPED WHICH WERE NOT EXPLICITLY DEVELOPED IN THE SCENARIO. IN TASK 2, HOWEVER, THE STUDENTS BEGAN SUGGESTING NEW ALTERNATIVES SUCH AS CONCURRENT DEVELOPMENT OF BOTH SYSTEMS [232] AND SUBSYSTEM DEVELOPMENT OF THE LAZER GUN [234]. THE STUDENT PRESENTATIONS OF THE LAST TASK SHOWED MANY MORE POSSIBLE OPTIONS DEVELOPED. BESIDES CONCURRENT AND SUBSYSTEM DEVELOPMENT, OTHER VARIATIONS INCLUDED CONSECUTIVE DEVELOPMENT OF BOTH SYSTEMS, INCORPORATION OF NEW TECHNOLOGICAL ADVANCES, USE OF THE LAZER IN ANY OF THE SYSTEMS, AND FURTHER CHANGES IN THE AVAILABLE CURRENT WEAPONS SYSTEMS [352]. THE PUSH WAS TOWARD FLEXIBILITY IN FUTURE PLANNING SITUATIONS.

STUDENT OPINIONS ON THE USE OF THE COMPUTER IN THE FIRST TWO TASKS WERE STRICTLY FAVORABLE, CITING THE INCREASED SPEED IN

HANDLING COMPUTATIONS AND COMPARISONS. AFTER RECONSIDERING THE PROBLEM AND CRITERIA IN TASK 3, THE STUDENTS BEGAN TO RECOGNIZE MANY LIMITATIONS IMPOSED BY FOLLOWING THE COMPUTER PROGRAMS. WHILE STILL APPRECIATING THE SPEED OF THE COMPUTER, THEY DETERMINED THAT THE VARIETY OF ALTERNATIVES WHICH COULD BE REPRESENTED BY THE PROGRAM WAS SEVERLY LIMITED [343]. SOME FLEXIBILITY IN DETERMINING PARAMETERS WAS LOST IN A PRE-DESIGNED PROGRAM AS WELL AS THE TIME-FRAME OVER WHICH THE PROBLEM COULD BE CONSIDERED. ONE SIGNIFICANT REALIZATION, WAS THAT THE COMPUTER COULDN'T SOLVE THE PROBLEM AND THAT THE COMPUTER SOLUTIONS WERE THE RESULT OF PREVIOUS ANALYSIS AND MUST BE SUBJECTED TO FURTHER ANALYSIS [344,345]. AND FURTHERMORE, ONCE THE ANALYST SUCCUMBED TO THE WAY OF THINKING OF THE COMPUTER, HIS CREATIVE AND INVENTIVE TALENTS TENDED TO BE LOST [342].

SEVERAL OTHER TOPICS WERE ADDRESSED IN THE STUDENT REPORTS. FOR EXAMPLE, DISCOUNTED COSTS WERE INTRODUCED IN TASK 1 BY ONE GROUP [126]. THIS TOPIC DREW INTEREST FROM OTHER GROUPS IN TASK 2, BUT IT WAS EVENTUALLY ABANDONED BY TASK 3.

THE HIGHER RISK INVOLVED IN DEVELOPING THE SS-1 WAS NOTED INITIALLY IN TASK 1 AND WAS MORE THOROUGHLY TREATED IN LATER TASKS.

MARGINAL ANALYSIS OF SEFU GAINED PER ADDITIONAL DOLLAR SPENT WAS INTRODUCED IN TASK 2 AND FURTHER DEVELOPED IN TASK 3 [252,353].

TASK 2 ALSO WAS THE FIRST TIME THAT A SIGNIFICANT DISCUSSION OF THE GUIDANCE (OR LACK OF GUIDANCE) PROVIDED CONCERNING BUDGET LIMITATIONS WAS ENCOUNTERED [251]. THIS TOPIC WAS EXPANDED TO GUIDANCE ON OBJECTIVES AND FORCE REQUIREMENTS IN THE LAST TASK PRESENTATIONS [351].

THE SIGNIFICANCE OF HIGH VERSUS LOW OPERATIONAL COSTS COMPARED TO DEVELOPMENT AND INVESTMENT COSTS AND THEIR IMPACT ON FUTURE PLANNING WAS MENTIONED IN THE SECOND TASK [254], HOWEVER, THIS TOPIC WAS NOT FURTHER DEVELOPED.

THE DISCUSSION OF SUCH A WIDE VARIETY OF TOPICS INDICATES THAT THE STUDENTS WERE INTERESTED IN MANY MORE ASPECTS OF THE PROBLEM THAN STRICTLY HAVING A MINIMUM BUDGET OR A PARTICULAR SEFU PROFILE. THE STUDENTS DID PROGRESS IN THEIR ABILITIES TO DIAGNOSE PROBLEMS AND DEVELOP SOLUTIONS AS THEY PROCEDED FROM TASK 1 THROUGH TASK 3. ONE NOTABLE EXCEPTION WAS THEIR FAILURE TO EXPLORE THE QUESTION OF A QUANTITATIVE OUTPUT MEASURE. NOW WE SHALL TURN OUR ATTENTION TO HOW THESE RESULTS RELATE TO OUR LEARNING OBJECTIVES.

RELATING RESULTS TO LEARNING OBJECTIVES

THE FIRST OBJECTIVE WAS TO FAMILIARIZE STUDENTS WITH SOME OF THE NON-QUANTITATIVE ASPECTS OF MILITARY DECISION PROBLEMS. THIS GOAL WAS ACHIEVED TO THE EXTENT THAT THE STUDENTS RECOGNIZED THAT FINDING THE PROBLEM OR PROBLEMS REQUIRING THEIR ATTENTION IS ONE OF THE MOST DIFFICULT JOBS THEY FACE. THEN ONCE A PROBLEM IS FOUND, PROPERLY DEFINING IT AND ITS

ENVIRONMENT POSES ANOTHER SIGNIFICANT TASK. MANY NON-QUANTIFIABLE FACTORS WERE OBSERVED AND DISCUSSED BY THE STUDENTS IN THEIR EFFORTS TO FIND SOLUTIONS TO THE QUESTIONS ASKED OF THEM. SUCH THINGS AS THE DESIRABILITY OF SPENDING MORE MONEY AT THE PRESENT IN ORDER TO GUARANTEE FLEXIBILITY IN THE FUTURE, THE TECHNOLOGICAL RISKS OF THE SYSTEMS, THE BUILT-IN CONSTRAINTS OF THE SYSTEM IN BOTH PAST AND FUTURE PERIODS CAUSED MANY STUDENTS TO HAVE MIS-GIVINGS OF RELYING SOLELY ON SEFU AND BUDGET COMPUTATIONS BY THE COMPUTER.

UNFORTUNATELY, DURING THE LIMITED TIME-FRAME IN WHICH FORSTRAN WAS ADMINISTERED (THREE WEEKS) NOT ALL OF THE DESIRED TOPICS MENTIONED IN CHAPTER I COULD BE THOROUGHLY ADDRESSED. THREE OF THE TOPICS WHICH DID NOT RECEIVE AS MUCH ATTENTION AS MIGHT HAVE BEEN DESIRABLE ARE SPECIFICALLY RELATED TO THE FIRST LEARNING OBJECTIVE, FAMILIARIZATION WITH NON-QUANTITATIVE ASPECTS OF DECISIONMAKING.

ALTHOUGH THIS EXERCISE WAS PARTICULARLY AIMED AT THE STRATEGIC RETALIATORY FORCES, ONE MAY HAVE EXPECTED SOME DISCUSSION OF HOW THESE FORCES FIT INTO THE ENTIRE DEFENSE SYSTEM. ALTHOUGH NO OTHER INFORMATION WAS EXPLICITLY PROVIDED, CERTAINLY ALTERNATIVES CONTINGENT UPON CHANGES IN OTHER SYSTEMS COULD POSSIBLY BE CONSIDERED. ALSO, NO CONSIDERATION WAS MADE OF HOW, SAY, A REDUCTION IN TACTICAL FORCES MIGHT INFLUENCE THE RIGIDNESS OF SEFU REQUIREMENTS IN OUR PROBLEM.

ANOTHER AREA LACKING DISCUSSION WAS THE USE AND STRICT

APPLICATION OF THE QUANTITATIVE OUTPUT MEASURE, THE SEFU. NO ONE SEEMED CONCERNED ABOUT HOW IT WAS DERIVED, WHAT IT MEASURED, OR HOW WELL IT MEASURED ANYTHING. AT LEAST SOME DISCUSSION OF QUANTITATIVE OUTPUT MEASURES AND THEIR USEFULNESS VERSUS THEIR LIMITATIONS WOULD HAVE BEEN DESIRABLE.

THE THIRD AREA WHICH WAS NOT FULLY EXPLORED CONCERNS THE RELATIONSHIPS BETWEEN DECISIONMAKERS AND ANALYSTS. THE STUDENTS SAW THE PROBLEM AS EVIDENCED BY THEIR DISCUSSIONS AND REQUESTS FOR GUIDANCE. HOWEVER, THEY NEVER DID EXPLICITLY EXPLORE THE PROBLEMS INVOLVED, NOR DID THEY ACTUALLY DETERMINE WHICH GROUP THEY ACTUALLY REPRESENTED. THE STUDENTS ASSUMED THEY WERE ANALYSTS, BUT NEVER REALLY ESTABLISHED THEIR RELATIONSHIPS TO A DECISIONMAKER.

THE SECOND OBJECTIVE DESIRED WAS TO INTRODUCE STUDENTS TO METHODS OF ANALYSIS OF BOTH QUANTITATIVE AND NON-QUANTITATIVE ASPECTS OF DECISIONMAKING. ULTIMATELY, OF COURSE, IT WAS HOPED THAT STUDENTS WOULD BE ABLE TO INTEGRATE THE NON-QUANTITATIVE ANALYSIS WITH QUANTITATIVE COMPUTATIONS OF SEFU AND BUDGET INTO A REASONABLE TOTAL ANALYSIS. THERE ARE NO FIRM RULES ON HOW TO ACHIEVE THIS INTEGRATION. THE BEST THAT CAN BE DONE IS THE EXPLICIT RECOGNITION AND EVALUATION OF AS MANY RELEVANT FACTORS AS CAN BE DETERMINED. THIS EFFORT THEN SHOULD LEAD TO THE DEVELOPMENT OF MANY ALTERNATIVE SOLUTIONS WHICH WILL DEMONSTRATE TO THE DECISIONMAKER THE SIGNIFICANCE OF

EMPHASIZING SOME FACTORS OVER OTHER FACTORS. THE STUDENTS PARTICIPATING IN FORSTRAN SEEMED TO IMPROVE IN THIS RESPECT AS THEY MOVED FROM TASK 1 THROUGH TASK 3. IN THE LAST TASK, THEY EFFECTIVELY USED BOTH NON-QUANTITATIVE AND QUANTITATIVE EVALUATIONS TO ANALYZE AND DETERMINE THE CRITERIA REQUIRED IN DEVELOPING THEIR SOLUTIONS. THE STUDENTS' REPEATED REQUESTS FOR GUIDANCE AND PROBLEM DEFINITION FURTHER REFLECTS THEIR RECOGNITION AND UTILIZATION OF RELEVANT DATA OF ALL TYPES [251,351]. WITHOUT SPECIFIC INSTRUCTIONS ON WHAT DATA TO USE IN THEIR DECISIONS, THE STUDENTS REALIZED THE IMPORTANCE OF PRESENTING ALTERNATIVES TO THE DECISIONMAKER WHICH REFLECTED AS MANY OF THE VARIOUS APPROACHES AS POSSIBLE.

FAMILIARIZATION OF THE STUDENT WITH USE OF COMPUTER APPLICATIONS TO SUPPORT THE ANALYSIS OF DECISIONMAKING PROBLEMS WAS THE THIRD OBJECTIVE DESIRED. THE DESIRED OUTCOME OF STUDENT RECOGNITION OF ADVANTAGES AND LIMITATIONS WAS REALIZED BY THE END OF TASK 3. THROUGH THE ACTUAL UTILIZATION OF TIME-SHARING DESIGNED PROGRAMS, THE STUDENTS HAD THE OPPORTUNITY TO OBTAIN FIRST-HAND EXPERIENCE IN USING PROGRAMS FOR SIMPLIFYING COMPUTATIONS. THE STUDENTS THEN COULD FORM OPINIONS AS TO THE USEFULNESS AND LIMITATIONS OF THE COMPUTER FROM THEIR OWN EXPERIENCE RATHER THAN FROM A TEXTBOOK. IN THIS PARTICULAR CASE, THE STUDENTS HAD THE UNIQUE OPPORTUNITY TO COMPARE TWO COMPLETELY DIFFERENT TIME-SHARE SYSTEMS AS THEY WERE SIMULTANEOUSLY DOING ANOTHER CASE IN ANOTHER COURSE ON ANOTHER COMPUTER SYSTEM.

FROM WATCHING FUTURE DECISIONMAKERS GRAPPLE WITH THIS CASE, IT APPEARS THAT FORSTRAN PROVIDES AN INSTRUCTOR WITH A RATHER FLEXIBLE TOOL TO RELATE PLANNING, BUDGETING, AND DECISIONMAKING. THE CONNECTIONS BETWEEN PLANNING CONSTRAINTS AND PREPARING BUDGETS, BUDGET CONSTRAINTS AND FUTURE PLANNING OPTIONS, AND THE ANALYSIS OF THE TOTAL SITUATION IN ORDER TO MAKE AN ACCURATE, RATIONAL DECISION ARE AMPLY ILLUSTRATED TO THE PARTICIPANT IN FORSTRAN. OF COURSE, MUCH RESPONSIBILITY REMAINS WITH THE INSTRUCTOR TO PROVIDE GUIDANCE TO THE CLASS TO INSURE DISCUSSION OF ALL RELEVANT FACTORS. IT IS CONCEIVABLE THAT THE SOLUTION OF THE CASE COULD DEGENERATE TO PRESENTATION OF A COMPUTER SOLUTION WITHOUT ANY CONSIDERATION AS TO HOW IT WAS OBTAINED. HOWEVER, THIS IS NOT THE INTENT OF FORSTRAN AND SHOULD NOT HAPPEN PROVIDED A CONSCIENTIOUS EFFORT IS MADE BY BOTH STUDENTS AND INSTRUCTORS TO UTILIZE THE CASE TO ITS FULLEST EXTENT.

CHAPTER IV

ANOTHER APPROACH - THE CASE STUDY METHOD

"THE SCHOOL OF EXPERIENCE IS NO SCHOOL AT ALL, NOT BECAUSE NO ONE LEARNS IN IT, BUT BECAUSE NO ONE TEACHES. TEACHING IS THE EXPEDITING OF LEARNING; A PERSON WHO IS TAUGHT LEARNS MORE QUICKLY THAN ONE WHO IS NOT."

- B. F. SKINNER

B. F. SKINNER'S STATEMENT ABOVE WELL SUMMARIZES THE PHILOSOPHY GUIDING THE DECISION TO UNDERTAKE THIS PROJECT. IT HAS LONG BEEN MAINTAINED BY MANY EXPERTS IN BOTH GOVERNMENT AND BUSINESS DECISIONMAKING POSITIONS THAT THE ONLY WAY TO BECOME A COMPETENT DECISIONMAKER WAS BY THE EXPERIENCE ATTAINED ON THE JOB. MANY EDUCATIONAL INSTITUTIONS HAVE RELIED SOLELY ON THE LECTURE METHOD OF INSTRUCTION WHICH DOES NOT PREPARE THE FUTURE DECISIONMAKER FOR HIS NEW JOB. HIS FINESSE IS LEFT TO DEVELOP ONLY BY EXPERIENCE. HOWEVER, A FEW SCHOOLS, MOST NOTABLY THE HARVARD BUSINESS SCHOOL, HAVE INCORPORATED AN APPROACH REFERRED TO AS THE CASE STUDY METHOD, WHICH GIVES STUDENTS THE OPPORTUNITY OF MAKING DECISIONS AND DEVELOPING A DECISION FRAMEWORK, AS PART OF THEIR EDUCATIONAL EXPERIENCE. THIS METHOD PROVIDES THE DISTINCT ADVANTAGE OF GIVING THE STUDENT THE CHANCE AND RESPONSIBILITY FOR MAKING DECISIONS WHILE

PERMITTING THE STUDENT AND HIS EMPLOYER TO ESCAPE FULL CONSEQUENCES OF A NOVICE'S ERRORS.

IN THIS CHAPTER WILL BE PRESENTED A DESCRIPTION OF THE CASE STUDY METHOD ALONG WITH SOME OF ITS ADVANTAGES AND DISADVANTAGES IN AN EFFORT TO INDICATE WHY THIS METHOD OUGHT TO BE CHOSEN AND HOW IT MAY BE USED AS AN INSTRUCTIONAL AID.

NOTES ON THE CASE STUDY METHOD (8)

THE CASE STUDY METHOD HAS BEEN UNDER DEVELOPMENT AT THE HARVARD BUSINESS SCHOOL FOR APPROXIMATELY HALF A CENTURY. IT CENTERS AROUND AN EMPHASIS ON STUDENT PARTICIPATION IN THE EDUCATIONAL PROCESS. THIS DIFFERS SIGNIFICANTLY FROM THE TRADITIONAL LECTURE TECHNIQUE WHICH DOES NOT INVOLVE ACTION ON THE PART OF PARTICIPANTS, BUT RATHER, SEEKS TO IMPLANT KNOWLEDGE OR INSTILL APPRECIATION OF THE SUBJECT MATTER BEING TAUGHT. THE CASE METHOD IS REALLY A PRACTICAL APPLICATION OF THE THEORY THAT THE POWER OF THINKING, AND NOT THE ACQUISITION OF FACTS, SHOULD BE OUR ULTIMATE EDUCATIONAL OBJECTIVE.

OF COURSE, WE RECOGNIZE THAT REAL-WORLD PROBLEMS TEND TO BE ENORMOUSLY COMPLEX. THERE ARE LITERALLY AN UNCOUNTABLE NUMBER OF INHERENT FACTS IN ANY SITUATION. OBVIOUSLY, SOME ATTRIBUTES OF THE PROBLEM MUST BE IGNORED IF A DECISION IS EVER TO BE MADE. THIS IS WHERE CASES HAVE OUTSTANDING VALUE. THEY ARE ANALOGUES OF EXACTLY THE KINDS OF PROBLEMS THAT WILL BE CONFRONTING THE DECISIONMAKER AFTER HIS EDUCATIONAL

EXPERIENCES. HIS PERSONAL SUCCESS AND HIS CONTRIBUTION TO HIS ORGANIZATION AND SOCIETY REST ON HIS ABILITY TO THINK THE PROBLEM THROUGH TO SOME INTELLIGENT SOLUTION BY ABSTRACTING FROM THE SITUATION THOSE FACTORS WHICH HE CONSIDERS TO BE MOST RELEVANT TO THE PROBLEM HE FACES AND CRITICALLY ANALYZING THOSE FACTORS IN MAKING HIS DECISION. PUT ANOTHER WAY, THE CASE SYSTEM, WHEN PROPERLY USED, INITIATES STUDENTS INTO THE WAYS OF INDEPENDENT THOUGHT AND RESPONSIBLE JUDGMENT.

BESIDES ITS REALISTIC AND LIFE-LIKE NATURE, SEVERAL OTHER ADVANTAGES HAVE BEEN ATTRIBUTED TO THE CASE METHOD. IT PROVIDES MUCH NEEDED EXPERIENCE TO THE PARTICIPANTS, SINCE THEY ARE CAST IN A ROLE OF DECISIONMAKER, RATHER THAN SIMPLY OBSERVING FROM THE OUTSIDE WHAT OTHER DECISIONMAKERS HAVE DONE. THIS ALSO TENDS TO ENHANCE INTEREST IN THE MATERIAL. SINCE ALL OF THE WORK HAS NOT BEEN DONE FOR THE STUDENT, THE CASE METHOD FORCES PARTICIPANTS TO DO SERIOUS ANALYTICAL AND CONSTRUCTIVE THINKING IN THE DECISIONMAKING ENVIRONMENT. IT IS NO LONGER SUFFICIENT FOR THE STUDENT TO SATISFY AN INSTRUCTOR, BUT HE MUST ALSO SUPPORT HIS DECISIONS AGAINST COUNTERATTACKS AND DISAGREEMENTS OF OTHERS IN THE GROUP, FURTHER STRENGTHENING THE INCENTIVE FOR ACCURATE, COMPLETE ANALYSIS.

IN ADDITION, THE CASE METHOD OFFERS PARTICIPANTS THE OPPORTUNITY TO LEARN THE SEMANTICS OF THEIR FIELD. BY USING THE VOCABULARY IN THE CONTEXT OF THE DECISIONMAKING

ENVIRONMENT, THEY LEARN THE MEANINGS, NOT AS DEFINITIONS, BUT AS THE SENSE AND THEY OBTAIN A FEELING FOR SHADES OF VARIED MEANING AMONG TERMS COMMONLY IN USE.

ANYTHING CLAIMING ADVANTAGES AS DESCRIBED ABOVE MUST SURELY FACE MANY DISADVANTAGES. THE CASE METHOD IS NO EXCEPTION. A BASIC KNOWLEDGE OF THE SUBJECT MATTER IS ASSUMED, AND IS THE RESPONSIBILITY OF THE STUDENT. THAT IMPLIES THAT BEFORE STUDENTS UNDERTAKE A LEARNING EXERCISE BY THE CASE METHOD THEY MUST HAVE ACQUIRED A BACKGROUND AND A KNOWLEDGE OF FACTS. TO GO ALONG WITH THEIR BACKGROUND KNOWLEDGE, THEY MUST HAVE A HIGH LEVEL OF MATURITY TO BE ABLE TO HANDLE INDEPENDENTLY THE ANALYSIS AND DECISIONS DEMANDED. PROGRESS IN LEARNING IS APT TO BE RATHER SLOW AS THE STUDENTS ACQUIRE SUFFICIENT EXPERIENCE IN USING THE CASE APPROACH.

TWO OTHER DISADVANTAGES ARE IN A SENSE RELATED. OBVIOUSLY, SINCE A CASE STUDY IS AN ABSTRACTION OF REALITY (IN SOME WAYS SIMILAR TO A MODEL), IT TENDS TO OVERSIMPLIFY THE SITUATION TO BE CONSIDERED. SIMPLIFICATION IS REQUIRED IN ANY SITUATION DEMANDING A DECISION, BUT IT IS FELT THAT OVERSIMPLIFICATION IN ONE DIRECTION DETRACTS FROM THE OVERALL REPRESENTATION OF THE PROBLEM. THEN AFTER THE PROBLEM IS OVERSIMPLIFIED, THERE IS AN OVEREMPHASIS ON POSITIVE DECISIONS TO TAKE ACTION WHETHER OR NOT THAT ACTION IS JUSTIFIED UNDER THE CIRCUMSTANCES. THERE IS A TENDANCY TO FORCE A SOLUTION WHERE ONE MAY NOT REALLY BE FEASIBLE OR WHERE THE DECISIONMAKER, IN A REAL SITUATION, WOULD BE

ACTING ON MANY MORE INPUTS THAN THOSE AVAILABLE IN THE CASE STUDY.

USING THE CASE STUDY METHOD

WITH THE PRECEDING DESCRIPTION OF THE CASE METHOD AND ITS ADVANTAGES AND DISADVANTAGES, IT MAY BE HELPFUL TO EXPLAIN THE REASONING INVOLVED IN SUGGESTING THIS METHOD OF PRESENTATION FOR THE FORCE STRUCTURE ANALYSIS PROBLEM, FORSTRAN. FORCE STRUCTURE ANALYSIS APPEARS TO BE AN AREA IN WHICH THERE ARE NO "SELF-EVIDENT TRUTHS." NO ONE CAN SAY WITH PERFECT IMPUNITY THAT FORCE A IS BETTER THAN FORCE B, OR THAT COST IS MORE IMPORTANT THAN EFFECTIVENESS, OR THAT MILITARY WISDOM WILL GUIDE A DECISION RATHER THAN POLITICS. THIS SITUATION IMMEDIATELY POINTS TO THE CASE METHOD, SINCE IT IS VERY DIFFICULT FOR THE FACT-ORIENTED LECTURE METHOD TO GET THE POINT OF MULTIPLE FEASIBLE SOLUTIONS ACROSS TO STUDENTS. FURTHERMORE, OUR EMPHASIS IS ON THE ABILITY OF A DECISIONMAKER TO ANALYZE, EVALUATE, AND DECIDE - IN SHORT, THINK - AND PROVIDE HIM WITH EXPERIENCE IN THIS AREA. THE CASE METHOD IS UNIQUELY DESIGNED FOR THIS EDUCATIONAL EXPERIENCE. THE OVERALL VARIETY, DIVERSITY, FLEXIBILITY, AND ADAPTABILITY AVAILABLE IN THE CASE METHOD MAKES IT IDEALLY SUITED TO OUR PROBLEM OF FORCE ANALYSIS.

FOR EXAMPLE, IN THE VERSION OF FORSTRAN WHICH WAS USED IN THIS STUDY, THE TASKS CALLED FOR A WRITTEN AND ORAL REPORT. THE ORAL REPORTS WERE ESSENTIALLY A RECAPITULATION OF THE

WRITTEN REPORTS. IN REALITY, THIS TYPE OF STRUCTURE MORE CLOSELY RESEMBLED A HOMEWORK PROBLEM IN AN ORDINARY LECTURE COURSE. IN PLACE OF THIS APPROACH, DISCUSSIONS BASED ON STUDENT EXPLORATION AND ANALYSIS OF THE QUESTIONS IN THE TASKS COULD BE INTRODUCED WHICH WOULD INVOLVE THE STUDENTS MORE DRAMATICALLY IN THE EXERCISE. THE WRITTEN REPORT SHOULD BE RETAINED, PRIMARILY AS A GUIDE TO STUDENT PREPARATION FOR THE EXERCISE.

THE MAJOR ADVANTAGE IN THIS CHANGE OF APPROACH WOULD BE INVOLVEMENT OF THE STUDENTS IN ACTIVELY SEEKING SOLUTIONS TO THE QUESTIONS ASKED, SUCH AS DEFINING THE PROBLEM, AND PRESENTING AND DEFENDING THEIR SOLUTIONS BEFORE THEIR PEERS. WHEN MAJOR LEARNING OBJECTIVES ARE OVERLOOKED, AS IN THE CASE OF QUANTITATIVE OUTPUT MEASURES, (*) THE INSTRUCTOR MAY PROVIDE GUIDANCE TO ELICIT STUDENT CONSIDERATION OF THOSE ISSUES. STUDENT PARTICIPATION AND THINKING COULD BE DIRECTED AWAY FROM THE FINAL NUMERICAL SOLUTION, WHERE IT APPEARED TO BE FOCUSED IN THE PRESENTATION USED IN THIS RESEARCH.

THE CASE METHOD SHOULD BE CONSIDERED TO PRESENT FORSTRAN BECAUSE IT APPEARS TO BE A MOST SUITABLE METHOD OF HANDLING THIS EXTREMELY COMPLEX PROBLEM WHICH IS TYPICAL OF THE GOVERNMENTAL DECISIONMAKING PROCESS. IT OFFERS THE OPPORTUNITY TO PRESENT A REAL-LIFE ANALOGUE WHICH CAN BE OF IMMENSE VALUE IN DEVELOPING THE ABILITY OF FUTURE GOVERNMENT DECISIONMAKERS.

(*) SEE PAGE 28.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

"WITH A HIGH DEGREE OF CONFIDENCE WE CAN SAY THAT THE INTUITIVE SOLUTION TO PROBLEMS OF COMPLEX SOCIAL SYSTEMS WILL BE WRONG MOST OF THE TIME."

- JAY W. FORRESTER

CONCLUSIONS

FROM THE DATA ACQUIRED IN THE LIMITED APPLICATION OF FORSTRAN DESCRIBED IN THIS STUDY, IT HAS BEEN FOUND THAT FORSTRAN ACCOMPLISHES AT LEAST THREE LEARNING OBJECTIVES WHICH MAY BE OF BENEFIT TO AN EDUCATOR TEACHING FUTURE DECISIONMAKERS. IT PROVIDES EXPERIENCE IN EVALUATING NON-QUANTITATIVE, AS WELL AS QUANTITATIVE, FACTORS OF DECISION PROBLEMS, INCLUDING THE FINDING, DEVELOPING, AND DEFINING OF THE PROBLEMS THEMSELVES. ALTHOUGH THREE TOPICS IN THIS AREA WERE NOT FULLY EXPLORED (QUANTITATIVE OUTPUT MEASURES, TOTAL DEFENSE SYSTEM IMPLICATIONS, AND DECISIONMAKER-ANALYST RELATIONSHIPS), OTHER STUDENT RESPONSES INDICATED THAT MOST OF THE SPECIFIC OBJECTIVES DESCRIBED IN CHAPTER I WERE REALISTICALLY ACHIEVED. STUDENTS SHOWED ABILITY TO INTEGPATE QUANTITATIVE AND NON-QUANTITATIVE FACTORS IN DEVELOPING AN INDIVIDUAL ANALYSIS METHODOLOGY FOR PROBLEM SOLUTION. FURTHER, THE PARTICIPANTS DEVELOPED AN UNDERSTANDING OF THE USE OF

COMPUTER APPLICATIONS TO ASSIST IN THE PERFORMANCE OF THEIR EVALUATIONS OF THE SOLUTIONS.

IT WAS ALSO EVIDENT THAT THE STUDENTS PROGRESSED IN THEIR ABILITIES TO DIAGNOSE PROBLEMS AND DEVELOP SOLUTIONS AS THEY PROCEDED THROUGH THE EXERCISE (TASK 1 TO TASK 3).

THE MAIN CONCLUSION OF THIS RESEARCH EFFORT IS THAT FORSTRAN PROVIDES A VIABLE METHODOLOGY FOR TEACHING FUTURE DECISIONMAKERS ABOUT THE RELATIONSHIPS DEVELOPED AMONG PLANNING, BUDGETING, AND DECISION PROCESSES. IT IS A METHODOLOGY WHICH OFFERS FUTURE DECISIONMAKERS AN OPPORTUNITY TO INTEGRATE QUANTITATIVE AND NON-QUANTITATIVE ASPECTS BEARING ON THEIR DECISIONS. IT GIVES THEM AN OPPORTUNITY TO DEFINE PROBLEMS AND THEN DEVELOP AND EVALUATE ALTERNATIVE SOLUTIONS TO THOSE PROBLEMS.

RECOMMENDATIONS

THE FOLLOWING PARAGRAPHS PRESENT RECOMMENDATIONS FOR FURTHER RESEARCH INVOLVING FORSTRAN AND ITS UTILIZATION AND OTHER RECOMMENDATIONS FOR RESEARCH IN AREAS RELATED TO TOPICS DISCUSSED IN THIS STUDY.

FURTHER IMPROVEMENT OF THE LEARNING OUTCOME CAN BE ACHIEVED, IT IS FELT, BY INTRODUCING THE TEACHING TECHNIQUES DISCUSSED IN CHAPTER IV. BY EMPLOYING THE CASE STUDY METHOD, A SKILLFUL INSTRUCTOR CAN ELICIT FROM THE STUDENTS EXTENSIVE DISCUSSION, EXPLORATION, AND CONSIDERATION OF THE DESIRED

LEARNING OBJECTIVES. THIS WILL EXTEND THE PROBLEM-FINDING OBJECTIVES OF FORSTRAN SINCE THE STUDENTS' ATTENTION WILL BE FOCUSED MORE ON DEFINING THE PROBLEMS THAN IN ACQUIRING AN UNEQUIVOCAL SOLUTION.

WORK TO DEVELOP SOMETHING OF AN OPTIMUM CASE BASED ON FORSTRAN COULD BE UNDERTAKEN. EXPLORATION OF THE SIGNIFICANCE OF THE WORDING OF VARIOUS PORTIONS OF THE SCENARIO AND TASKS TOWARD ELICITING SPECIFIC STUDENT RESPONSES COULD BE OF BENEFIT TO FURTHER UTILIZATION OF THE CASE. A DIFFERENT STRUCTURING OF THE TASKS REQUIRED MAY ALSO IMPROVE LEARNING OUTCOMES OR ALTER SIGNIFICANCE OF VARIOUS FACTORS CONSIDERED BY PARTICIPANTS BASED ON THE SPECIFIC INTENT FOR USING THIS CASE.

FURTHER RESEARCH IN RELATED AREAS COULD BE UNDERTAKEN TO ENHANCE THE LEARNING OUTCOMES OF THIS CASE. FOR EXAMPLE, THE COST FIGURES USED IN FORSTRAN WERE GIVEN AS AN INPUT OF A COST ANALYSIS TEAM. A CASE STUDY COULD BE CREATED FOR A FINANCIAL MANAGEMENT COURSE CONCERNED WITH COST ESTIMATING TECHNIQUES WHICH WOULD DEVELOP THE COST FIGURES BY METHODOLOGIES TAUGHT IN THE FINANCIAL COURSE.

ADDITIONALLY, ANOTHER CASE COULD BE WRITTEN FOR AN ECONOMIC ANALYSIS COURSE WHICH WOULD DEVELOP THE QUANTITATIVE OUTPUT MEASURE. THIS WOULD HELP INSURE AN IN-DEPTH CONSIDERATION OF THIS EXTREMELY IMPORTANT TOPIC.

FORSTRAN COULD BE INCORPORATED INTO A SERIES OF CASE STUDIES

DEVELOPED SPECIFICALLY FOR TEACHING MILITARY OR GOVERNMENTAL DECISIONMAKERS, OR IT COULD BE MODIFIED FOR USE IN CORPORATE (PROFIT-MAKING) TRAINING ENVIRONMENTS.

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APPENDIX A

THE SCENARIO AND TASKS

FORCE STRUCTURE ANALYSIS - FORSTRAN

SCENARIO

SETTING

IN THE YEAR 19XX, THE DEPARTMENT OF DEFENSE (DOD) AGAIN FINDS ITSELF CONFRONTED WITH THE NEED TO DEVELOP FORCE STRUCTURE PLANS FOR ITS ENTIRE ARRAY OF COMBAT FORCES UNDER RELATIVELY TIGHT BUDGET CONSTRAINTS. ALTHOUGH THE SIZE OF THE DEFENSE BUDGET HAS GRADUALLY INCREASED SINCE THE EARLY SEVENTIES, COSTS AND THE SOPHISTICATION OF WEAPON SYSTEMS HAVE CORRESPONDINGLY INCREASED SO THAT DOLLAR RESOURCES ARE CRITICAL AND DECISIONS MUST BE MADE AS TO WHICH NEWLY PROPOSED WEAPON SYSTEMS PROVIDE THE BEST FORCE FOR THE DOLLAR.

DURING THE LAST FEW YEARS THERE HAVE BEEN WIDE SPREAD OUTBREAKS OF PARTICULARLY VIRULENT DISEASES THROUGHOUT THE WORLD. MANY OF THESE OUTBREAKS HAVE OCCURRED IN THE MORE WEALTHY NATIONS OF THE WORLD WHERE THE STANDARD OF LIVING HAS BEEN RELATIVELY HIGH; WHILE A NUMBER OF AGRARIAN SOCIETIES HAVE ESCAPED THESE OUTBREAKS. AS A RESULT, MANY MAJOR GOVERNMENTS, INCLUDING THE U.S., HAVE HAD TO DIVERT A LARGE PERCENTAGE OF THEIR NATIONAL RESOURCES TO HEALTH SERVICES AND MEDICAL RESEARCH.

IN SPITE OF THIS NEW THREAT TO MANKIND, MAJOR CONFLICT, SIMILAR TO THE COLD WAR OF THE FIFTIES AND SIXTIES, CONTINUES TO EXIST BETWEEN BLOCKS OF NATIONS. HOWEVER, THE ALLIANCES ARE BASED MORE ON THE HAVE-HAVE NOT ALIGNMENT OF NATIONS RATHER THAN THE FORMER FREE WORLD-COMMUNIST BLOCK ORIENTATION. THUS THE UNITED STATES FINDS ITSELF A MAJOR POWER IN THE "HAVE" NATION BLOCK, AND IT PROVIDES THE MAJOR DETERRENT TO WORLD WAR THROUGH THE DEVELOPMENT OF HIGHLY SOPHISTICATED STRATEGIC WEAPON SYSTEMS. THE "HAVE NOT" NATIONS HAVE DEVELOPED STRONG ARMED FORCES BASED PRIMARILY ON HUGE RESOURCES OF MANPOWER WHICH RESULTED FROM A POORLY CONTROLLED POPULATION EXPLOSION IN MANY PARTS OF THE WORLD. SINCE THE FAMOUS SCIENTIFIC BREAKTHROUGH TEN YEARS AGO WHICH PERMITS THE INEXPENSIVE CONVERSION OF SEA LIFE INTO A VERY EDIBLE HUMAN NUTRITIONAL SUPPLEMENT, THE "HAVE NOT" NATIONS HAVE BEEN ABLE TO DIRECT RESOURCES TO "DEFENSE" AND HAVE PUSHED R&D EXPENDITURES ON WEAPONS SYSTEMS AND ARE CURRENTLY DEVELOPING A LARGE NUMBER OF RELATIVELY SOPHISTICATED SYSTEMS. THESE RECENT INVESTMENTS WHEN COMBINED WITH THEIR LARGE MANPOWER RESOURCES PROJECT A MILITARY THREAT OF INCREASING CONCERN TO THE U.S. AND HER ALLIES.

THE THREAT

INTENSIVE STUDY AND ANALYSIS OF INTELLIGENCE DATA PROVIDES STRONG SUPPORT FOR THE BELIEF THAT THE UNITED STATES MUST INCREASE ITS PRESENT STRATEGIC RETALIATORY STRENGTH BY AT LEAST A THIRD DURING THE NEXT FIVE YEARS OF THE CURRENT PLANNING CYCLE IF IT IS TO MAINTAIN STRATEGIC PARITY BETWEEN THE "HAVE" AND "HAVE NOT" POWER BLOCKS. THE PRESIDENT OF THE UNITED STATES HAS DIRECTED THE DEPARTMENT OF DEFENSE TO PLAN FOR THIS INCREASE AND PRESENT THEIR RECOMMENDATIONS TO HIM FOR INCLUSION IN THE STATE OF THE NATION ADDRESS IN JANUARY.

POLITICAL BACKGROUND

ON THE OTHER SIDE OF THE COIN, THE NEXT CALENDAR YEAR IS A PRESIDENTIAL ELECTION YEAR AND THE INCUMBENT IS UP FOR REELECTION AGAINST WHAT APPEARS TO BE A FORMIDABLE OPPONENT OF THE LIBERAL OPPOSITION PARTY. THE LIBERAL PARTY HAS BEEN A CONSISTENT OPPONENT OF EXCESSIVE FEDERAL SPENDING, AND THE LEADING LIBERAL CANDIDATE IS AN OUTSPOKEN CRITIC OF THE CURRENT PRESIDENT ON THE SUBJECT OF THE BUDGET. THE PRESIDENT HAS BECOME INCREASINGLY MORE SENSITIVE TO THIS CRITICISM AND HAS EXERTED CONSIDERABLE PRESSURE ON ALL EXECUTIVE DEPARTMENTS TO HOLD DOWN PROPOSED BUDGET EXPENDITURES FOR THE NEXT FISCAL YEAR.

THE ECONOMY

THE NATION AGAIN SUFFERS FROM EXCESSIVE INFLATION DUE TO "AN OVERHEATED" ECONOMY. FISCAL EXPERTS HAVE REPEATEDLY CALLED FOR CUTBACKS IN FEDERAL EXPENDITURES AND SUGGEST CONSIDERABLE REDUCTION IN MILITARY AND HEALTH EXPENDITURES.

SYSTEMS

DISCUSSION OF SYSTEMS

CURRENTLY THREE STRATEGIC RETALIATORY SYSTEMS ARE IN EXISTENCE, THEY ARE THE SM-1, THE B-1, AND THE SLBM. THESE SYSTEMS ARE RESPECTIVELY: A SILO BASED MISSILE, A MANNED BOMBER, AND A SUBMARINE BASED MISSILE SYSTEM. THE CURRENT PHILOSOPHY ON VIEWING STRATEGIC RETALIATORY SYSTEMS HAS NOT CHANGED IN ANY ESSENTIAL FORM FROM THAT HELD DURING THE EARLY SEVENTIES. A QUOTATION BY THE CHIEF OF STAFF OF THE AIR FORCE (CSAF), MADE IN 1970, CONTINUES TO BE APPLICABLE AND EXPRESS THE CURRENT PHILOSOPHY.

> AGAINST THE CRITICAL POSSIBLITY OF AN ATTACK ON THIS COUNTRY, WE MUST HAVE THE CAPABILITY TO DESTROY THE ENEMY'S STRATEGIC WEAPONS AND A SECOND STRIKE CAPABILITY THAT WOULD DETER THE ENEMY FROM A FULL SCALE ATTACK IN THE FIRST PLACE.
>
> WE'RE CONVINCED THAT THE STRATEGIC FORCE SHOULD CONTINUE TO INCLUDE MANNED BOMBERS AND LAND BASED AND SEA BASED MISSILES. THIS COMBINATION OF RETALIATORY WEAPONS ... COMPLICATES THE ENEMY'S PROBLEM OF TARGETING AND TIMING AND ADDS TO HIS PROBLEM OF DEFENSE AGAINST A COORDINATED COUNTER-ATTACK.

EFFECTIVENESS

RECENT BREAKTHROUGHS IN MANAGEMENT SCIENCE HAVE PERMITTED THE DEVELOPMENT OF USEFUL OBJECTIVE MEASURES FOR CERTAIN OUTPUTS OF GOVERNMENT. ONE SUCH MEASURE IS THE "SEFU" (PRONOUNCED SEE-FOO) OR STRATEGIC EFFECTIVENESS UNIT; THE SEFU PERMITS QUALITATIVE ASSESSMENTS OF EFFECTIVENESS WHICH HAVE BEEN GAINED FROM WAR-GAMING AND A MYRIAD OF OTHER STUDIES TO BE COMBINED WITH CERTAIN OBJECTIVE MEASURES WHICH RELATE TO A SYSTEM. THE RESULTING SEFU THEN CAN BE USED AS A SINGLE OBJECTIVE MEASURE FOR COMPARING SYSTEMS WITHIN A LIKE CLASS SUCH AS STRATEGIC RETALIATORY SYSTEMS. TOTAL EFFECTIVENESS OF A SET CAN ALSO BE MEASURED 'VIS A VIS' AN OPPOSING SET WITHIN THE SAME CLASS WITH A HIGH DEGREE OF CONFIDENCE. IT SHOULD BE POINTED OUT THAT SOME SUBJECTIVE CONSIDERATIONS SUCH AS THE WEAPONS MIX DISCUSSED ABOVE CAN BE ADDRESSED SEPARATELY AS A POSSIBLE ADVANTAGE OR DISADVANTAGE OVER AND ABOVE THE ABSOLUTE SEFU MEASURE.

THE TASKS

THE ANALYSIS OF DECISION-MAKING PROBLEMS FACING DOD HAS ALREADY BEEN STRUCTURED TO SOME EXTENT. FOR EXAMPLE, PAST DECISIONS HAVE PLACED CONSTRAINTS ON FUTURE WEAPONS ACQUISITION DECISIONS BY ESTABLISHING A CURRENT FORCE STRUCTURE. THE PRESENT SYSTEMS HAVE BEEN THOROUGHLY EXAMINED AND SEVERAL FEASIBLE ALTERNATIVE CONFIGURATIONS HAVE BEEN PROPOSED. THE NEXT SECTION OF THIS PAPER PRESENTS DETAILS ON THE COST AND EFFECTIVENESS OF THE CURRENTLY AVAILABLE WEAPONS SYSTEMS.

FOLLOWING THE DATA ON THE CURRENT SYSTEMS, COST AND EFFECTIVENESS DATA IS PRESENTED ON TWO NEWLY PROPOSED, COMPETING WEAPON SYSTEMS. THIS DATA WAS DERIVED FROM EXTENSIVE COST ESTIMATING METHODOLOGY AND FORCE EFFECTIVENESS STUDIES WHICH WERE PREVIOUSLY COMPLETED.

THE LAST SECTION ESTABLISHES THE SET OF RULES GOVERNING THE FORCE STRUCTURE ANALYSIS METHODOLOGY WHICH IS USED TO DEVELOP AND EVALUATE PROPOSED ALTERNATIVE FORCE STRUCTURES.

THREE DECISION-MAKERS ARE ASKED TO DEVELOP AN OPTIMUM FORCE STRUCTURE. THEIR POSITIONS REPRESENT RESEARCH AND DEVELOPMENT, CURRENT BUDGETING, AND LONG-RANGE PLANNING VIEWPOINTS. THE INTENT IS TO COMBINE CURRENT SYSTEMS WITH A PROPOSED SYSTEM (SUBJECT TO THE RULES) TO ESTABLISH A NEW FORCE STRUCTURE WHICH WILL MEET DOD'S NEEDS AS PRESENTED IN THE PRECEDING BACKGROUND MATERIAL.

CURRENT SYSTEMS

THE SM-1

THIS SYSTEM HAS BEEN IN OPERATIONAL STATUS FOR SEVERAL YEARS AND IS RAPIDLY BECOMING OBSOLESCENT. IT IS CURRENTLY SCHEDULED FOR A PHASE OUT IN THE FIFTH YEAR OF THIS PLANNING CYCLE. ITS RELATIVELY HIGH OPERATIONAL COSTS ALSO CONTRIBUTED TO THE DECISION TO ELIMINATE IT FROM THE INVENTORY. THE APPLICABLE DATA FOR THE FIVE-YEAR PHASE OUT ARE AS FOLLOWS:

YEAR	1	2	3	4	5	6	7	8	9	10
QUANTITY	500	450	400	300	200	0	0	0	0	0
SEFU	800	700	450	400	150	0	0	0	0	0
COSTS:										
R&D	0	0	0	0	0	0	0	0	0	0
INVESTMENT	0	0	0	0	0	0	0	0	0	0
OPERATIONS	5.8	5.2	4.8	3.2	2.4	0	0	0	0	0

EXHAUSTIVE STUDIES HAVE SHOWN THAT THERE ARE REALLY ONLY TWO OTHER PHASE OUT SCHEDULES WHICH MIGHT BE CONSIDERED IN THE DEVELOPMENT OF THE FORCE STRUCTURE. ONE IS A FOUR YEAR PHASE OUT SCHEDULE AND THE OTHER IS BASED ON A THREE YEAR SCHEDULE. SUCH ACCELERATED PHASE OUT SCHEDULES CARRY WITH THEM COST PENALTIES AS WELL AS A PENALTY IN REDUCED EFFECTIVENESS. THESE PENALTIES HAVE MANY ROOTS AND THE INEFFFICIENCIES INVOLVED IN RETRAINING AND RELOCATION OF PERSONNEL, REPLANNING AND RETARGETING, RESTRUCTURING OF COMMUNICATIONS SYSTEMS ARE BUT A FEW OF THE PROBLEM ORIGINS.

THE FOUR YEAR PHASE OUT ALTERNATIVE IS SHOWN BELOW:

QUANTITY	450	350	250	100	0	0	0	0	0	0
SEFU	700	400	200	50	0	0	0	0	0	0
COSTS:										
R&D	0	0	0	0	0	0	0	0	0	0
INVESTMENT	0	0	0	0	0	0	0	0	0	0
OPERATIONS	4.5	4.0	3.3	2.0	0	0	0	0	0	0

THE THREE YEAR PHASE OUT ALTERNATIVE IS SHOWN BELOW:

QUANTITY	400	250	50	0	0	0	0	0	0	0
SEFU	500	100	25	0	0	0	0	0	0	0
COSTS:										
R&D	0	0	0	0	0	0	0	0	0	0
INVESTMENT	0	0	0	0	0	0	0	0	0	0
OPERATIONS	5.7	4.0	2.5	0	0	0	0	0	0	0

THE B-1

THIS SYSTEM IS CURRENTLY IN THE ACQUISITION PHASE OF THE WEAPON SYSTEM PROCUREMENT CYCLE. IT REPLACES THE AGED B-83, WHICH HAS BEEN PHASED OUT OF THE INVENTORY DURING THE PAST THREE YEARS. A TARGET FORCE STRUCTURE OF 600 AIRPLANES HAS BEEN FIXED FOR SEVERAL YEARS WITH THE PRODUCTION RUN SCHEDULED TO TERMINATE ABOUT FOUR YEARS FROM THE PRESENT TIME (YEAR 3 OF THE PLANNING CYCLE).

YEAR	1	2	3	4	5	6	7	8	9	10
QUANTITY	200	400	600	600	600	600	600	600	600	600
SEFU	1000	1300	1700	1700	1650	1600	1500	1400	1300	1200
COSTS:										
R&D	1.5	0	0	0	0	0	0	0	0	0
INVESTMENT	4.0	4.0	4.0	0	0	0	0	0	0	0
OPERATIONS	3.0	6.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0

STUDIES WERE RECENTLY COMPLETED WHICH EXAMINED ALTERNATIVE PROCUREMENT SCHEDULES FOR THE B-1. THE RESULTS SHOWED THAT THE PRODUCTION RUN FOR 600 A/C COULD BE SHORTENED OR EXTENDED ABOUT ONE YEAR. BEYOND THAT POINT, COST PENALTIES FOR FURTHER ADJUSTMENT BECAME PROHIBITIVE. SIMILAPLY, THE ONLY EFFICIENT TRADEOFF IN ADJUSTING THE TOTAL FORCE TARGET WAS TO REDUCE THE TOTAL PRODUCTION RUN TO 400 A/C; THIS WAS BEST ACHIEVED BY SIMPLY TERMINATING THE PRODUCTION RUN A YEAR EARLY. THE THREE ALTERNATIVE ACTIONS WHICH MIGHT BE CONSIDERED IN ADDITION TO THE PRESENT PLAN ARE SHOWN BELOW.

600 A/C -- 1 YEAR EXTENSION OF PRODUCTION

QUANTITY	200	350	500	600	600	600	600	600	600	600
SEFU	1000	1150	1400	1700	1650	1600	1500	1400	1300	1200
COSTS:										
R&D	1.5	0	0	0	0	0	0	0	0	0
INVESTMENT	2.5	2.5	2.5	2.5	0	0	0	0	0	0
OPERATIONS	3.0	5.3	7.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0

600 A/C -- 1 YEAR CONTRACTION OF PRODUCTION

QUANTITY	250	600	600	600	600	600	600	600	600	600
SEFU	1000	1400	1700	1700	1650	1600	1500	1400	1300	1200
COSTS:										
R&D	1.5	0	0	0	0	0	0	0	0	0
INVESTMENT	9.0	9.0	0	0	0	0	0	0	0	0
OPERATIONS	4.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0

400 A/C -- TERMINATION OF CONTRACT 1 YEAR EARLY

QUANTITY	200	400	400	400	400	400	400	400	400	400
SEFU	1000	1250	1300	1350	1300	1250	1200	1150	1100	1050
COSTS:										
R&D	1.5	0	0	0	0	0	0	0	0	0
INVESTMENT	3.5	3.5	0	0	0	0	0	0	0	0
OPERATIONS	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

THE SLBM

LIKE THE SM-1, THIS SYSTEM HAS BEEN IN OPERATION FOR MANY YEARS AND HAS OBSOLESCED TO SOME EXTENT. HOWEVER, A RECENTLY APPROVED MODIFICATION PROGRAM IS IN THE DEVELOPMENT STAGE, AND WHEN THE ENTIRE FLEET SYSTEM HAS BEEN MODIFIED, THE TOTAL SYSTEM EFFECTIVENESS WILL BE GREATLY IMPROVED AND SYSTEM LIFE EXTENDED.

YEAR	1	2	3	4	5	6	7	8	9	10
QUANTITY	300	300	300	300	300	300	300	300	300	300
SEFU	1200	1150	1050	1200	1350	1500	1400	1300	1200	1100
COSTS:										
R&D	1.0	1.0	1.0	0	0	0	0	0	0	0
INVESTMENT	0	0	2.0	2.0	2.0	0	0	0	0	0
OPERATIONS	7.0	7.0	7.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

SEVERAL ALTERNATIVES REMAIN OPEN WITH RESPECT TO MODIFYING CURRENT PROGRAM PLANS. THE PROGRAM COULD BE PHASED DOWN BEGINNING IN YEAR (1); HOWEVER, ANALYSIS HAS SHOWN THAT CANCELLATION OF RESEARCH CONTRACTS AND CERTAIN INTERNATIONAL COMMITMENTS PERMIT ONLY ONE PROGRAM PHASE DOWN SCHEDULE AND THIS IS SHOWN BELOW. ALTERNATIVELY, THE CURRENT MODIFICATION PROGRAM CAN BE CANCELLED SO THAT THE SLBM FORCE WOULD REVERT TO THE ORIGINAL SCHEDULE OF OBSOLESCENCE, THIS IS SHOWN AS THE SECOND ALTERNATIVE BELOW. FINALLY, THE MODIFICATION PROGRAM CAN BE CONTRACTED OR EXTENDED AS SHOWN IN OPTIONS THREE AND FOUR BELOW.

YEAR	1	2	3	4	5	6	7	8	9	10
PHASE OUT PROGRAM										
QUANTITY	275	225	150	50	0	0	0	0	0	0
SEFU	1100	900	350	100	0	0	0	0	0	0
COSTS:										
R&D	3.5	0	0	0	0	0	0	0	0	0
INVESTMENT	0	0	0	0	0	0	0	0	0	0
OPERATIONS	5.0	4.5	4.0	1.0	0	0	0	0	0	0
CANCELLATION OF THE MOD PROGRAM										
QUANTITY	300	300	300	300	300	300	300	300	150	100
SEFU	1200	1150	1050	900	800	700	600	500	200	100
COSTS:										
R&D	3.5	0	0	0	0	0	0	0	0	0
INVESTMENT	0	0	0	0	0	0	0	0	0	0
OPERATIONS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	2.5
CONTRACTION OF THE MOD PROGRAM										
QUANTITY	300	300	300	300	300	300	300	300	300	300
SEFU	1200	1150	1400	1550	1700	1600	1500	1400	1300	1200
COSTS:										
R&D	2.0	2.0	0	0	0	0	0	0	0	0
INVESTMENT	0	2.5	2.0	2.0	0	0	0	0	0	0
OPERATIONS	7.0	7.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EXTENSTION OF THE MOD PROGRAM										
QUANTITY	300	300	300	300	300	300	300	300	300	300
SEFU	1200	1150	1050	950	1000	1200	1400	1300	1200	1100
COSTS:										
R&D	.6	.6	.6	.6	0	0	0	0	0	0
INVESTMENT	0	0	0	3.5	3.5	0	0	0	0	0
OPERATIONS	7.0	7.0	7.0	7.0	6.0	5.0	5.0	5.0	5.0	5.0

NEW SYSTEMS

THE B-2

THIS PROPOSED SYSTEM IS A HYPERSONIC MANNED BOMBER WITH A SUB-ORBITAL TRAJECTORY THAT PERMITS NON-STOP, UNREFUELED FLIGHT WITH DELIVERY OF MULTI-PURPOSE PAYLOADS TO ANY POINT ON EARTH. ITS FLEXIBILITY IS FURTHER ENHANCED BY A NEARLY ASSURED CAPABILITY TO LAUNCH FROM DIRT STRIPS OF 3000 TO 5000 FEET IN LENGTH.

THE COSTS ASSOCIATED WITH THIS PROGRAM ARE SHOWN BELOW.

R&D COSTS (4 YEAR PROGRAM)	$8.0 BILLION
INVESTMENT COSTS	SEE FIGURE 1
ANNUAL OPERATIONS COSTS	$50 MILLION/UNIT

THE SS-1

THIS PROPOSED SYSTEM IS AN ADVANCED SPACE WEAPON THAT USES A LASER-DISINTEGRATOR GUN FOR TARGET DESTRUCTION FROM LOW EARTH ORBIT PASSES. ITS FLEXIBILITY IS ENHANCED BY A NEWLY DISCOVERED ORBITAL TRACK TRANSLATOR; UNFORTUNATELY, CONSIDERABLE DEVELOPMENT WORK REMAINS TO BE DONE BEFORE THE TRANSLATOR CAN BE MADE OPERATIONALLY RELIABLE. ADDITIONALLY, SOME FUNDS (APPROXIMATELY $5 BILLION) ARE SLATED FOR EXTENSIVE TESTING AND CALIBRATION OF THE LASER GUN.

THE COSTS ASSOCIATED WITH THIS PROGRAM ARE SHOWN BELOW.

R&D COSTS (INCLUDING LASER)	$18.0 BILLION
INVESTMENT COSTS	SEE FIGURE 1
ANNUAL OPERATIONS COSTS	$20 MILLION/UNIT

EFFECTIVENESS

THE EFFECTIVENESS OF BOTH SYSTEMS ARE SHOWN IN GRAPHICAL FORM IN FIGURE 2. THE EFFECTIVENESS OF LARGER FORCE SIZE (LARGER THAN 400 UNITS) HAS BEEN EXAMINED FOR BOTH SYSTEMS; AND IN BOTH CASES STUDIES REVEALED THAT THE POTENTIAL ENEMY'S DEFENSIVE FORCE STRUCTURE RESPONSE TO EXTREMELY LARGE U.S. FORCE SIZE WOULD MORE THAN OUTWEIGH ANY ADVANTAGES ACCRUING TO THE UNITED STATES.

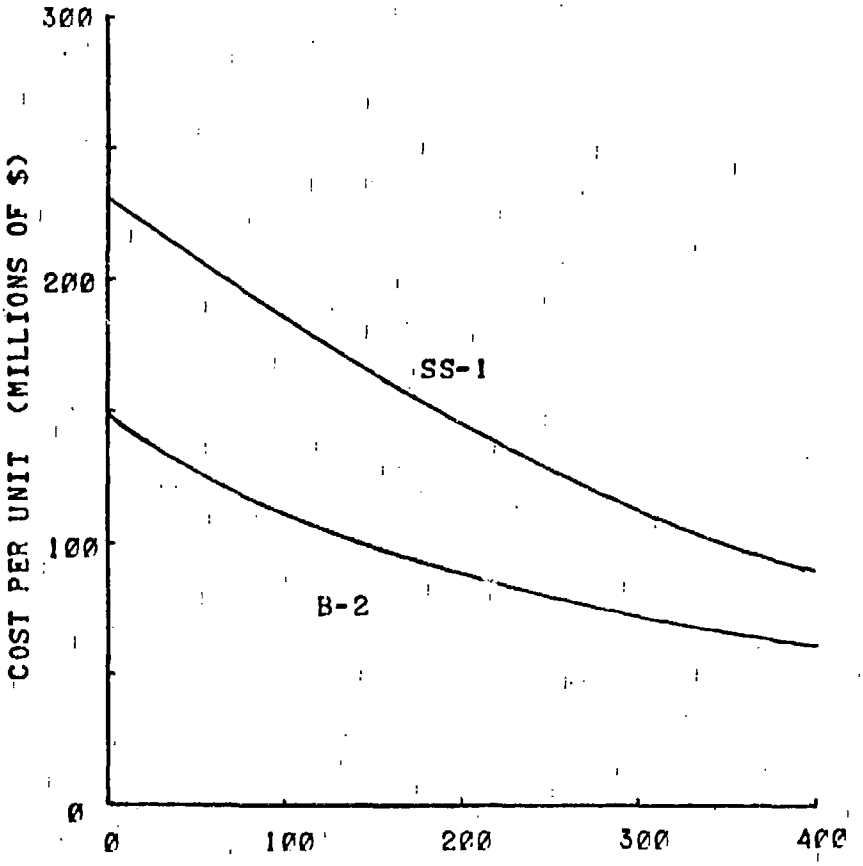

FIGURE 1. INVESTMENT COSTS FOR NEW SYSTEMS

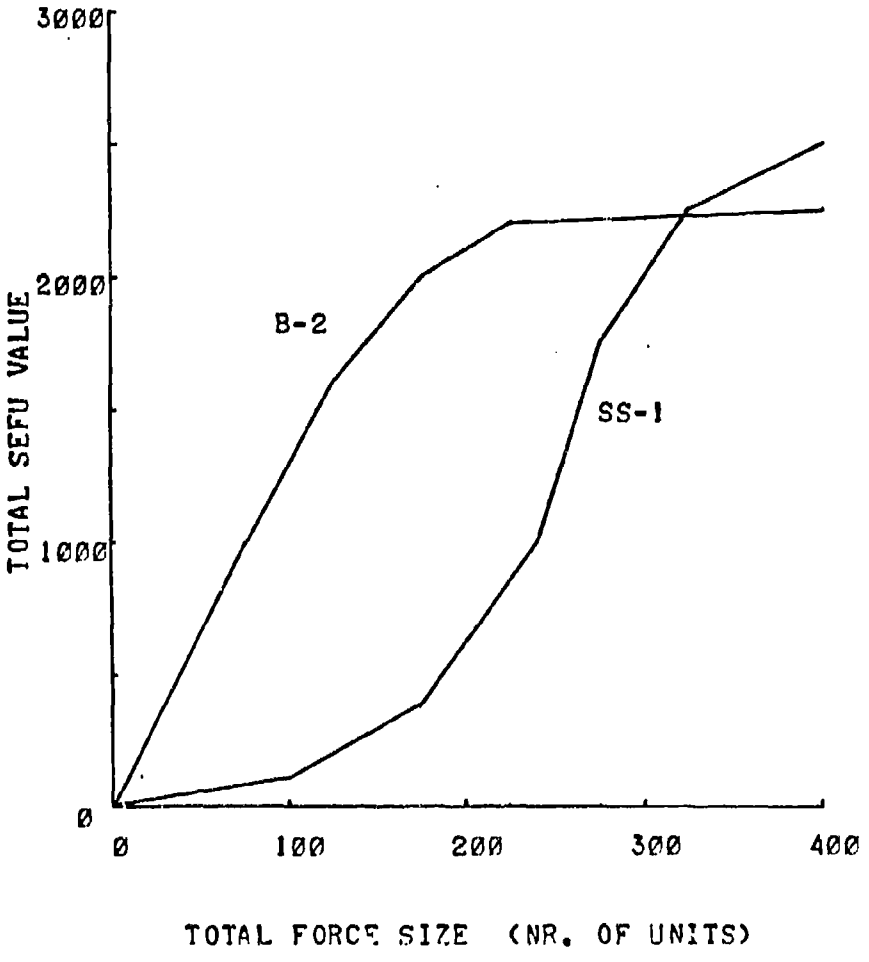

FIGURE 2. SEFU VALUES FOR NEW SYSTEMS

TABLE 1. INVESTMENT COST AND SEFU FOR NEW SYSTEMS

NO.	SS-1 INVEST	B-2 INVEST	SS-1 SEFU	B-2 SEFU
0	229.7	156.1	0.	0.
25	216.6	141.9	25.0	333.3
50	204.3	130.2	50.0	666.7
75	192.7	120.2	75.0	1000.0
100	181.8	111.7	100.0	1300.0
125	171.5	104.2	191.7	1600.0
150	161.8	97.7	283.3	1800.0
175	152.6	92.0	375.0	2000.0
200	143.9	86.9	615.4	2100.0
225	135.8	82.4	855.8	2200.0
250	128.0	78.3	1214.3	2207.1
275	120.8	74.5	1750.0	2214.3
300	113.9	71.2	2000.0	2221.4
325	107.5	68.1	2250.0	2228.6
350	101.4	65.2	2333.3	2235.7
375	95.6	62.6	2416.7	2242.9
400	90.2	60.2	2500.0	2250.0

RULES FOR THE EXERCISE

THE FOLLOWING RULES APPLY FOR ANALYSIS OF NEW SYSTEMS.

1. R&D AND INVESTMENT COSTS MAY RUN CONSECUTIVELY OR MAY OVERLAP BY ONE YEAR, BUT INVESTMENT AND OPERATIONAL COST MUST OVERLAP IN ALL BUT THE FIRST YEAR OF INVESTMENT. SEE EXAMPLE BELOW.

YEAR	1	2	3	4	5	6	7	8	9	10
	R	R	R	R						
				I	I	I				
					0	0	0	0	0	0

2. THE NORMAL TIME REQUIRED FOR EXPENDITURE UNDER EACH COST CATEGORY ARE LISTED BELOW.

R&D	4 YEARS
INVESTMENT	3 YEARS
OPERATIONS	VARIABLE

3. THE TIME REQUIRED FOR PHASES OF SYSTEM DEVELOPMENT MAY BE VARIED ACCORDING TO THE FOLLOWING RULES.

A. THE R&D PHASE MAY BE EXPANDED OR CONTRACTED ONE YEAR SO THAT THE TOTAL TIME FOR THE R&D PHASE (ANY NEW PROGRAM) MAY BE EITHER 3, 4, OR 5 YEARS IN LENGTH.

(1) IF THE PHASE IS REDUCED TO THREE YEARS, TOTAL R&D COSTS FOR THAT PROGRAM MUST BE INCREASED 50% AND THEN DIVIDED OVER THE NEW THREE YEAR PERIOD AS SHOWN IN EXAMPLE BELOW.

NORMAL R&D ESTIMATED EXPENDITURE: $12.0 BILLION

WHEN ACCELERATED TO A THREE YEAR R&D PHASE, THE TOTAL EXPENDITURE BECOMES 1.5 * 12.0 = 18.0 AND THE R&D EXPENSE FOR EACH OF THE THREE YEARS IS NOW $6.0 BILLION.

(2) IF THE PHASE IS EXPANDED TO FIVE YEARS, THE TOTAL EXPENDITURE MAY BE REDUCED BY A FACTOR OF .8 AND THE NORMAL EXPENDITURE SHOWN IN (1) ABOVE BECOMES .8 * 12.0 = $9.6 AND THE EXAMPLE CAN BE SHOWN GRAPHICALLY BELOW.

YEAR	1	2	3	4	5
NORMAL	3.0	3.0	3.0	3.0	
EXPANDED	1.9	1.9	1.9	1.9	1.9

B. SIMILARLY, THE INVESTMENT PHASE CAN BE EXPANDED OR REDUCED AS INDICATED BELOW.

(1) IF THE PRODUCTION PHASE IS REDUCED TO 2 YEARS, THE TOTAL COST OF PRODUCTION MUST BE INCREASED BY A FACTOR OF 1.25 AND SPREAD EVENLY OVER THE TWO YEAR PERIOD.

(2) IF THE PRODUCTION PHASE IS EXPANDED TO FOUR YEARS, THEN A FACTOR OF .9 MAY BE APPLIED TO THE TOTAL COST. THE INVESTMENT COSTS ARE THEN EVENLY DISTRIBUTED OVER THE FOUR YEARS.

SO TOTAL PRODUCTION COSTS OF $10.0 MAY BE SHOWN AS:

YEAR	1	2	3	4
NORMAL	3.3	3.3	3.3	
REDUCED	6.25	6.25		
EXPANDED	2.25	2.25	2.25	2.25

4. THE NEW FORCE DOES NOT BECOME EFFECTIVE UNTIL THE SECOND YEAR OF INVESTMENT, AND THE INCREMENTAL BUILDUP OF THE FORCE IS DIRECTLY RELATED TO THE NUMBER OF YEARS USED IN THE INVESTMENT PHASE. THUS, THE NORMAL THREE YEAR INVESTMENT PHASE WILL PERMIT THE FORCE TO BE BUILT UP IN EQUAL INCREMENTS OVER THREE YEARS AS SHOWN BELOW FOR A FORCE OF 300 UNITS.

YEAR	1	2	3	4	5	6	7	8	9	10
PHASES	R	R	R	RI	I0	I0	0	0	0	0
FORCE SIZE	0	0	0	0	100	200	300	300	300	300

A TWO YEAR INVESTMENT PHASE WOULD PERMIT 1/2 OF THE FORCE TO BECOME EFFECTIVE EACH YEAR DURING A TWO YEAR BUILD UP.

5. THE SEFU OR TOTAL FORCE EFFECTIVENESS IS DIRECTLY RELATED TO FORCE SIZE DURING THE BUILD UP. ONCE THE TOTAL FORCE SIZE HAS BEEN SELECTED, THE TOTAL SEFU VALUE CAN BE DETERMINED FROM THE CHARTS, AND THIS TOTAL SEFU VALUE MUST INCREASE AT A CONSTANT RATE OVER THE PERIOD OF FORCE BUILD UP AS SHOWN BELOW. FOR A TOTAL FORCE OF 300 UNITS WHICH HAVE AN INITIAL TOTAL SEFU VALUE OF 3000, THE BUILD UP IS

YEAR	1	2	3
FORCE SIZE	100	200	300
SEFU	1000	2000	3000

6. OBSOLESCENCE WILL BEGIN OR BE SHOWN AS BEGINNING IN THE YEAR FOLLOWING PEAK SYSTEM EFFECTIVENESS. IT WILL BE SHOWN BY SUBTRACTING 5% OF THE TOTAL ORIGINAL SEFU VALUE DURING EACH SUCCESSIVE YEAR. THE DECLINING BALANCE WOULD APPEAR AS FOLLOWS (DECLINE STARTS IN 4TH YEAR):

SEFU TOTAL 800 1600 2400 2280 2160 2040 ETC.

7. OPERATING COSTS ARE DIRECTLY PROPORTIONAL TO TOTAL FORCE SIZE. A VALUE FOR ANNUAL OPERATING COSTS PER UNIT WILL BE STATED FOR EACH NEW SYSTEM, AND THE TOTAL FORCE COST FOR ANNUAL OPERATIONS WILL BE THE AGGREGATE OF COST PER UNIT. THUS IF ONE UNIT WILL REQUIRE AN OPERATING EXPENDITURE OF $50,000,000 PER YEAR, THEN A TOTAL FORCE OF 300 UNITS WILL HAVE AN ANNUAL OPERATING COST OF $15,000,000,000.

FIRST TASK

YOU ARE ADVISORS TO THE DEPUTY CHIEF OF STAFF FOR RESEARCH AND DEVELOPMENT (DCS/R&D). THE CSAF HAS INDICATED THAT THE NEW WEAPON SYSTEM TO BE DEVELOPED AT THIS TIME SHOULD PRODUCE 2000 SEFU WHEN FULLY OPERATIONAL. EFFECTIVENESS STUDIES ALREADY ACCOMPLISHED ON THE NEW SYSTEMS UNDER CONSIDERATION INDICATE THAT A FORCE OF 175 B-2'S OR A FORCE OF 300 SS-1'S WILL ACHIEVE THIS GOAL. THE CSAF HAS FURTHER ADVISED THAT THERE IS A SMALL POSSIBILITY THAT BOTH SYSTEMS COULD BE DEVELOPED ON A CONCURRENT BASIS, BUT THAT ONLY ONE SYSTEM WILL BECOME OPERATIONAL.

THE DCS/R&D HAS ASKED YOU TO RECOMMEND (1) A DECISION ON THE DEVELOPMENT OF THE NEW SYSTEMS AND (2) ANY ALTERATION(S) OF THE CURRENT FORCE STRUCTURE WHICH YOU FIND DESIRABLE AT THIS TIME. HE WISHES TO KNOW THE IMPACT OF THESE DECISIONS ON THE R&D BUDGET IN YEAR ONE AND SUCCEEDING YEARS OF THE CURRENT TEN-YEAR PLANNING CYCLE.

SPECIFICALLY, YOU ARE TO RESPOND WITH A TEN-MINUTE BRIEFING AND A WRITTEN SUMMARY (2-4 TYPED PAGES) WHICH EXPLAINS:

(1) YOUR PERSONAL UNDERSTANDING OF THE BUDGET PROBLEM

(2) YOUR CRITERIA FOR ANALYSIS

(3) YOUR RECOMMENDATIONS

(4) EFFECT THAT THE COMPUTER PROGRAMS HAD ON YOUR ANALYSIS AND DECISION

(5) OTHER CONSIDERATIONS.

SECOND TASK

YOU HAVE BEEN ASSIGNED TO THE BUDGET COMMITTEE TO PREPARE NEXT YEAR'S STRATEGIC FORCES BUDGET FOR PRESENTATION TO CONGRESS. THIS BUDGET INCLUDES A TEN-YEAR PROJECTION OF BUDGET ESTIMATES. THE CSAF HAS SUGGESTED THAT THE COMMITTEE CAREFULLY CONSIDER THE PREVAILING POLITICAL, SOCIAL, AND ECONOMIC CLIMATE AND PREPARE A CURRENT YEAR'S BUDGET WHICH WILL MINIMIZE LENGTHY CONGRESSIONAL DEBATE. THERE IS VIRTUALLY NO CHANCE THAT BOTH NEW SYSTEMS MAY BE OBTAINED OVER AN EXTENDED PERIOD OF TIME.

THE CSAF HAS ASKED YOU TO RECOMMEND (1) A DECISION ON THE ACQUISITION OF THE NEW SYSTEMS AND (2) ANY ALTERATION(S) OF THE CURRENT FORCE STRUCTURE WHICH YOU FIND DESIRABLE AT THIS TIME. HE WISHES TO KNOW THE IMPACT OF THESE DECISIONS ON THE TOTAL BUDGET, PARTICULARLY AS THEY PERTAIN TO THE PENDING BUDGET SUBMISSION TO CONGRESS, BUT ALSO ON SUCCEEDING YEARS OF THE CURRENT TEN-YEAR PLANNING CYCLE.

SPECIFICALLY, YOU ARE TO RESPOND WITH A TEN-MINUTE BRIEFING AND A WRITTEN SUMMARY (2-4 TYPED PAGES) WHICH EXPLAINS:

(1) YOUR PERSONAL UNDERSTANDING OF THE BUDGET PROBLEM

(2) YOUR CRITERIA FOR ANALYSIS

(3) YOUR RECOMMENDATIONS

(4) EFFECT THAT THE COMPUTER PROGRAMS HAD ON YOUR ANALYSIS AND DECISION

(5) OTHER CONSIDERATIONS.

NOTE: IGNORE ANY IMPLICATIONS OR DECISIONS DERIVED IN THE FIRST TASK.

THIRD TASK

AS A MEMBER OF THE AIR FORCE FORCE STRUCTURE COMMITTEE, YOU HAVE BEEN APPOINTED CHAIRMAN OF A DOD COMMITTEE TO DEVELOP AND EVALUATE ALTERNATIVES FOR THE FUTURE STRATEGIC FORCE STRUCTURE. THE SECRETARY HAS ASKED YOU TO COST ALTERNATIVE FORCE STRUCTURES WHICH MIGHT BE MADE UP IF EITHER THE B-2 OR SS-1 PROGRAM WERE APPROVED. THERE IS ESSENTIALLY ZERO PROBABILITY THAT BOTH SYSTEMS COULD BE OBTAINED ON A CONCURRENT BASIS.

THE SECRETARY OF DEFENSE HAS ASKED YOU TO RECOMMEND (1) A DECISION ON THE DEVELOPMENT OF THE NEW SYSTEMS AND (2) ANY ALTERATION(S) OF THE CURRENT FORCE STRUCTURE WHICH YOU FIND DESIRABLE AT THIS TIME. HE WISHES TO KNOW THE IMPACT OF THESE DECISIONS ON EFFECTIVENESS AND BUDGET LEVELS OVER AT LEAST THE CURRENT TEN-YEAR PLANNING CYCLE.

SPECIFICALLY, YOU ARE TO RESPOND WITH A TEN-MINUTE BRIEFING AND A WRITTEN SUMMARY (2-4 TYPED PAGES) WHICH EXPLAINS:

(1) YOUR PERSONAL UNDERSTANDING OF THE PROBLEMS

(2) YOUR CRITERIA FOR ANALYSIS

(3) YOUR RECOMMENDATIONS

(4) EFFECT THAT THE COMPUTER PROGRAMS HAD ON YOUR ANALYSIS AND DECISION

(5) OTHER CONSIDERATIONS.

NOTE: IGNORE ANY IMPLICATIONS OR DECISIONS DERIVED IN THE PREVIOUS TASKS.

APPENDIX B

COMPUTER PROGRAMS

B.1 TEACH
B.2 IDENT
B.3 RDP
B.4 RDF
B.5 PRES
B.6 FORCE

APPENDIX B.1

COMPUTER PROGRAM - TEACH

```
1000C      *****   INSTRUCTIONS & INFORMATION   *****
1001C
1002C GENERAL FILES DESCRIPTION
1003C
1004C THIS PROGRAM, FSATEACH, GIVES GENERAL INFORMATION
1005C AND INSTRUCTIONS FOR RUNNING A FORCE STRUCTURE
1006C ANALYSIS (FORSTRAN) IN SM6.02, FEDERAL GOVERNMENT
1007C FINANCIAL MANAGEMENT.  FORSTRAN IS COMPOSED OF
1008C FIFTEEN COMPUTER FILES, FIVE OF WHICH ARE
1009C COMPUTATION PROGRAMS, NINE THAT ARE DATA FILES,
1010C AND ONE INSTRUCTIONAL PROGRAM.  EACH OF THESE
1011C FILES ARE DESCRIBED BELOW.
1012C
1013C FSAIDENT & FSAIDOUT
1014C
1015C FROM THE SCENARIO IT CAN BE DETERMINED THAT THERE
1016C ARE 60 POSSIBLE COMBINATIONS OF ALTERNATIVES FOR
1017C THE FORCE STRUCTURE COMPOSED OF THE CURRENT WEAPONS
1018C SYSTEMS (SM-1, B-1, SLBM).  THESE 60 OPTIONS ARE
1019C IDENTIFIED BY NUMBER FOR EASE IN COMPUTER
1020C MANIPULATION.  THE PROGRAM FSAIDENT BUILDS AN
1021C OUTPUT DATA FILE CALLED FSAIDOUT WHICH CORRELATES
1022C THE NUMERICAL IDENTIFICATIONS USED IN ALL
1023C COMPUTATION PROGRAMS WITH A VERBAL DESCRIPTION OF
1024C THE FORCE STRUCTURE.  FSAIDENT HAS THE OPTION
1025C OF CREATING A MASTER LIST OF ALL 60 IDENTIFICATIONS
1026C OR OF OUTPUTING SINGLE OPTIONS TO THE TELETYPE.
1027C
1028C FSARDC, FSACOST, & FSASEFU
1029C
1030C THESE FILES ARE INPUT DATA FILES.  FSARDC
1031C PROVIDES THE ANNUAL R&D COST FIGURES FOR THE
1032C 3 ALTERNATIVES OF SM-1, 4 ALTERNATIVES OF B-1,
1033C AND 5 ALTERNATIVES OF SLBM.  FSACOST PROVIDES
1034C THE ANNUAL TOTAL COST FIGURES AND FSASEFU PROVIDES
1035C THE ANNUAL SEFU (EFFECTIVENESS) FIGURES FOR THE
1036C SAME SET OF ALTERNATIVES
1037C
1038C FSARDP & FSAPRES
1039C
1040C FSARDP USES THE DATA IN FSARDC AND FSASEFU
1041C TO COMPUTE THE ANNUAL R&D COST FIGURES AND THE
1042C ANNUAL SEFU VALUES FOR EACH OF THE 60 POSSIBLE
1043C COMBINATIONS OF SM-1, B-1, AND SLBM, I.E., THE
1044C CURRENT FORCE STRUCTURE OPTIONS.  FSAPRES USES
1045C THE DATA IN FSACOST AND FSASEFU TO MAKE SIMILAR
1046C COMPUTATIONS REPRESENTING TOTAL COST FIGURES AND
1047C SEFU VALUES FOR THE CURRENT FORCE OPTIONS.
1048C
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1049C FSAOLDRD, FSAOLDC, & FSAOLDS
1050C
1051C THESE FILES ARE THE OUTPUT DATA FILES FOR THE
1052C PROGRAMS FSARDP AND FSAPRES.  FSAOLDRD CONTAINS
1053C THE R&D COST DATA.  FSAOLDC CONTAINS THE
1054C TOTAL COST DATA.  FSAOLDS CONTAINS THE
1055C SEFU VALUES.  ALL THREE FILES CONTAIN SIXTY
1056C LINES OF DATA, EACH REPRESENTING ONE OF THE
1057C SIXTY POSSIBLE CURRENT FORCE STRUCTURE OPTIONS.
1058C
1059C FSARDF & FSAFORCE
1060C
1061C THESE TWO PROGRAMS INTEGRATE CURRENT FORCE
1062C STRUCTURE ALTERNATIVES WITH NEW SYSTEM (SM-1
1063C OR B-2) PROPOSED STRUCTURES.  FSARDF COMPUTES
1064C R&D COSTS (AND SEFU VALUES) BASED ON FIXED
1065C INVESTMENT AND OPERATIONS CRITERIA, FIXED QUANTITIES
1066C TO BE PURCHASED, AND ARBITRARY MINIMUM SEFU
1067C REQUIREMENTS.  THE STUDENT IS REQUIRED TO
1068C INPUT THREE PARAMETERS:
1069C     (1)  THE TYPE OF NEW SYSTEM TO BE ACQUIRED
1070C     (2)  THE LENGTH OF THE R&D PERIOD
1071C     (3)  THE YEAR IN WHICH R&D IS TO START.
1072C
1073C FSAFORCE COMPUTES TOTAL COST FIGURES (AND SEFU
1074C VALUES) FOR AN OLD SYSTEM PLUS A NEW SYSTEM.
1075C THE STUDENT IS REQUIRED TO INPUT A SET OF
1076C CRITERIA WHICH THE COMPOSITE FORCE STRUCTURE
1077C MUST MEET ALONG WITH A SET OF PARAMETERS
1078C DESCRIBING THE NEW WEAPONS SYSTEM TO BE
1079C PURCHASED.  THE PROGRAM THEN AUTOMATICALLY
1080C ADDS THE NEW SYSTEM TO ALL SIXTY POSSIBLE
1081C OLD FORCE OPTIONS AND COMPARES THEM AGAINST
1082C THE CRITERIA.  THE OUTPUT CONSISTS OF ONLY
1083C THOSE COMBINATIONS THAT MET OR BETTERED THE
1084C MINIMUM CRITERIA.  THE CRITERIA THAT MUST BE
1085C INPUT DURING PROGRAM EXECUTION (AND THEREFORE
1086C DETERMINED PRIOR TO RUNNING) INCLUDE:
1087C     (1)  TEN VALUES (ONE FOR EACH OF THE NEXT TEN
1088C          YEARS) WHICH ESTABLISH THE MAXIMUM BUDGET
1089C          (COST) ALLOWED FOR THE TOTAL FORCE MIX.
1090C     (2)  TEN VALUES (ONE FOR EACH OF THE NEXT TEN
1091C          YEARS) WHICH ESTABLISH THE MINIMUM SEFU
1092C          (EFFECTIVENESS) PERMITTED FOR THE TOTAL
1093C          FORCE MIX.
1094C THEN THE NEW SYSTEM PARAMETERS ARE REQUIRED:
1095C     (3)  THE TYPE OF NEW SYSTEM TO BE ACQUIRED
1096C     (4)  THE LENGTH OF THE R&D PERIOD
1097C     (5)  THE YEAR IN WHICH R&D IS TO START
1098C     (6)  THE LENGTH OF THE INVESTMENT PERIOD
1099C     (7)  WHETHER OR NOT R&D AND INVESTMENT
1100C          PERIODS WILL OVERLAP.
1101C     (8)  THE RANGE OF QUANTITY DESIRED FOR PURCHASE.
1102C          THIS CONSISTS OF TWO NUMBERS, THE SMALLER
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1103C          AND THE LARGER LIMITS TO BE CONSIDERED.
1104C          THE PROGRAM AUTOMATICALLY CONSIDERS THE
1105C          VALUES BETWEEN THESE LIMITS IN INCREMENTS
1106C          OF FIVE VEHICLES.
1107C
1108C BOTH FSARDF AND FSAFORCE STORE ALL FEASIBLE
1109C SOLUTIONS ON DATA FILES (RDSOLN AND SOLN,
1110C RESPECTIVELY).  THE PROGRAMS THEN WILL INDICATE
1111C THE TOTAL NUMBER OF FEASIBLE SOLUTIONS ON FILE.
1112C THE STUDENT MAY THEN DETERMINE WHETHER HE WANTS
1113C A LISTING OF THE SOLUTIONS OR WANTS TO RE-RUN THE
1114C PROGRAM WITH DIFFERENT CRITERIA AND/OR PARAMETERS.
1115C
1116C RDSOLN & SOLN
1117C
1118C THESE DATA FILES ARE THE FINAL OUTPUT (ALL
1119C FEASIBLE SOLUTIONS) FROM THE PROGRAMS FSARDF
1120C AND FSAFORCE.  THIS IS THE DATA WHICH IS USED
1121C FOR FINAL ANALYSIS TO REACH A DECISION.  IT
1122C MAY BE LISTED ON THE TELETYPE OR ON A LINE
1123C PRINTER.  HOWEVER, IT IS RECOMMENDED THAT THE
1124C STUDENT ALSO SAVE THE DATA IN A PERSONAL DATA
1125C FILE IN CASE FURTHER REFERENCE IS REQUIRED
1126C (MACHINE FAILURE, DUPLICATE COPIES, ETC.).
1127C
1128C IDENTIFICATION OF VARIABLE SYMBOLS
1129C
1130C ACI      ANNUAL COST OF INVESTMENT FOR NEW SYSTEM
1131C ASN      ANNUAL SEFU FROM NEW SYSTEM
1132C BUD      MAXIMUM BUDGET ALLOWANCE IN A GIVEN YEAR
1133C C1       INPUT COST MATRIX FOR SM-1
1134C C2       INPUT COST MATRIX FOR B-1
1135C C3       INPUT COST MATRIX FOR SLBM
1136C CI       TOTAL COST OF INVESTMENT FOR NEW SYSTEM
1137C COP      ANNUAL COST OF OPERATING NEW SYSTEM
1138C CRD      COST FOR R&D IN A GIVEN YEAR
1139C INVT     LENGTH OF INVESTMENT PERIOD
1140C NC       NEW PROGRAM COST
1141C NO       NUMBER (QUANTITY) OF NEW SYSTEM VEHICLES
1142C OC       OLD (OR CURRENT) PROGRAMS TOTAL COST
1143C OL       OVERLAP PERIOD FOR R&D AND INVESTMENT
1144C ORC      OLD (OR CURRENT) PROGRAMS R&D COST
1145C OS       OLD (OR CURRENT) PROGRAMS SEFU
1146C PC       TOTAL PROGRAM COSTS (NEW + OLD)
1147C PRC      R&D PROGRAM COSTS (NEW + OLD)
1148C PS       PROGRAM SEFU (NEW + OLD)
1149C RD       TOTAL R&D COST FOR A NEW SYSTEM
1150C RDLENG   LENGTH OF R&D PERIOD
1151C S1       INPUT SEFU MATRIX FOR SM-1
1152C S2       INPUT SEFU MATRIX FOR B-1
1153C S3       INPUT SEFU MATRIX FOR SLBM
1154C SN       TOTAL SEFU DUE TO NEW SYSTEM
1155C SR       MINIMUM SEFU REQUIREMENT IN A GIVEN YEAR
1156C START    YEAR FOR START OF R&D
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1157C TYPE    NEW SYSTEM TYPE (SS-1 OR B-2)
1158C UCOP    UNIT OPERATING COST
1159C
1160C
1900C       ***   FSATEACH   ***
1902C
1904 1 FORMAT (1H )
1906 PRINT 1
1908 PRINT: "THIS PROGRAM GIVES INSTRUCTIONS & INFORMATION"
1910 PRINT: "FOR RUNNING FORCE STRUCTURE
1912& ANALYSIS (FORSTRAN)."
1914 PRINT: "WHEN THE NEXT  *  APPEARS, TYPE THE SEQUENCE"
1916 PRINT: "'LIST XXXX,YYYY', WHERE XXXX AND YYYY ARE"
1918 PRINT: "4-DIGIT LINE NUMBERS CORRESPONDING TO"
1920 PRINT: "THE DESCRIPTION BELOW."
1922 PRINT 1
1924 PRINT 1
1926 PRINT: "INFORMATION DESIRED                XXXX  YYYY"
1928 PRINT 1
1930 PRINT: "ALL INSTRUCTIONS                   1000  1158"
1932 PRINT: "GENERAL FILES DESCRIPTION          1002  1011"
1934 PRINT: "FSAIDENT & FSAIDOUT                1013  1026"
1936 PRINT: "FSARDC, FSACOST, & FSASEFU         1028  1036"
1938 PRINT: "FSARDP & FSAPRES                   1038  1047"
1940 PRINT: "FSAOLDRD, FSAOLDC, & FSAOLDS       1049  1057"
1942 PRINT: "FSARDF & FSAFORCE                  1059  1114"
1944 PRINT: "RDSOLN & SOLN                      1116  1126"
1946 PRINT: "IDENTIFICATION OF SYMBOLS          1128  1158"
1999 STOP;END
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APPENDIX B.2

COMPUTER PROGRAM - IDENT

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2000C   THIS PROGRAM IS CALLED  FSAIDENT.
2005C
2010C   THIS PROGRAM IDENTIFIES THE CODE NUMBER
2015C   OF CURRENT FORCE MIXES GIVEN IN THE
2020C   PROGRAMS FSAPRES AND FSAFORCE, ("N").
2025C   THESE CODES ARE ALSO USED IN THE
2030C   PROGRAMS FSARDP AND FSARDF.
2035C
2040 ASCII S(12,4),A(3,4)
2045C
2050 FILENAME FSAIDOUT
2055C
2060C  ESTABLISH ASCII VARIABLE NAMES
2065C
2070 S(1,1)=4H5 YR;S(1,2)=4H PHA;S(1,3)=4HSE 0;S(1,4)=4HUT
2075 S(2,1)=4H4 YR;S(2,2)=4H PHA;S(2,3)=4HSE 0;S(2,4)=4HUT
2080 S(3,1)=4H3 YR;S(3,2)=4H PHA;S(3,3)=4HSE 0;S(3,4)=4HUT
2085 S(4,1)=4H 600;S(4,2)=4H NOR;S(4,3)=4HMAL ;S(4,4)=4H
2090 S(5,1)=4H 600;S(5,2)=4H EXT;S(5,3)=4HENSI;S(5,4)=4HON
2095 S(6,1)=4H 600;S(6,2)=4H CON;S(6,3)=4HTRAC;S(6,4)=4HTION
2100 S(7,1)=4H 400;S(7,2)=4H TER;S(7,3)=4HMINA;S(7,4)=4HTION
2105 S(8,1)=4H   P;S(8,2)=4HRESE;S(8,3)=4HNT  ;S(8,4)=4H
2110 S(9,1)=4H   P;S(9,2)=4HHASE;S(9,3)=4H OUT;S(9,4)=4H
2115 S(10,1)=4H   N;S(10,2)=4HO MO;S(10,3)=4H
2120 S(10,4)=4H    ;S(11,1)=4H   C;S(11,2)=4HONTR
2125 S(11,3)=4HACT ;S(11,4)=4HMOD ;S(12,1)=4H   E
2130 S(12,2)=4HXTEN;S(12,3)=4HD MO;S(12,4)=4HD
2135C
2140 FSAIDOUT=8HFSAIDOUT
2145 END FILE FSAIDOUT
2150C
2155 1 FORMAT (1H ,I2,3X,4A4)
2160 2 FORMAT (1H&,4A4)
2165 3 FORMAT (1H )
2170 4 FORMAT (1X)
2175 5 FORMAT (I2,3X,3(4A4))
2180 6 FORMAT (34HTHIS OUTPUT IDENTIFIES THE CURRENT,
2185& 24H FORCE STRUCTURE OPTIONS)
2190 7 FORMAT (1H0,2H N,9X,4HSM-1,13X,3HB-1,15X,4HSLBM//)
2195 8 FORMAT (1X/2H N,9X,4HSM-1,13X,3HB-1,15X,4HSLBM/1X)
2200C
2205 PRINT 3
2210 PRINT:"IF YOU WANT MASTER OUTPUT
2215& WRITTEN TO A FILE - ENTER 1"
2220 PRINT:"OTHERWISE (TELETYPE OUTPUT ONLY) - ENTER 0"
2225 READ: KOUT
2230 PRINT 3
2235 IF (KOUT) 88,89,88
2240C
```

```
2245C  ROUTINE FOR WRITING OUTPUT TO TELETYPE
2250C
2255 89 PRINT: "ENTER 60 FOR MASTER LIST,
2260& 1 FOR ONE-AT-A-TIME VALUES"
2265 READ:K
2270 IF (K.EQ.60) GO TO 80
2275 PRINT 3
2280 83 PRINT:"INPUT VALUE OF N FOR WHICH 'ID' IS DESIRED"
2285 READ: N
2290 PRINT 7
2295 GO TO 82
2300C
2305C  COMPUTE & PRINT SM-1 OPTION
2310C
2315 80 PRINT 7
2320 N=1
2325 81 IF (N.EQ.61) GO TO 94
2330 82 N1=((N-1)/20)+1
2335 GO TO (11,12,13),N1
2340 11 PRINT 1,N,(S(1,I),I=1,4)
2345 GO TO 91
2350 12 PRINT 1,N,(S(2,I),I=1,4)
2355 GO TO 91
2360 13 PRINT 1,N,(S(3,I),I=1,4)
2365C
2370C  COMPUTE & PRINT B-1 OPTION
2375C
2380 91 N2=((N-1-(20*(N1-1)))/5)+1
2385 GO TO (21,22,23,24),N2
2390 21 PRINT 2,(S(4,I),I=1,4)
2395 GO TO 92
2400 22 PRINT 2,(S(5,I),I=1,4)
2405 GO TO 92
2410 23 PRINT 2,(S(6,I),I=1,4)
2415 GO TO 92
2420 24 PRINT 2,(S(7,I),I=1,4)
2425C
2430C  COMPUTE & PRINT SLBM OPTION
2435C
2440 92 N3=N-(20*(N1-1))-(5*(N2-1))
2445 GO TO (31,32,33,34,35),N3
2450 31 PRINT 2,(S(8,I),I=1,4)
2455 GO TO 93
2460 32 PRINT 2,(S(9,I),I=1,4)
2465 GO TO 93
2470 33 PRINT 2,(S(10,I),I=1,4)
2475 GO TO 93
2480 34 PRINT 2, (S(11,I),I=1,4)
2485 GO TO 93
2490 35 PRINT 2,(S(12,I),I=1,4)
2495C
2500C  ROUTINE TO REPEAT FOR TELETYPE OUTPUT
2505C
2510 93 N=N+1
```

```
2515 IF (K.EQ.60) GO TO 81
2520 PRINT 3
2525 PRINT:"ANOTHER N?  1 FOR YES, 0 FOR NO"
2530 READ:K
2535 IF (K) 94,94,83
2540C
2545C  ROUTINE FOR WRITING TO FILE
2550C
2555 88 WRITE (FSAIDOUT,6)
2560 WRITE (FSAIDOUT,4)
2565 WRITE (FSAIDOUT,8)
2570C
2575 DO 71 N=1,60
2580C  COMPUTE SM-1 OPTION
2585 N1=((N-1)/20)+1
2590 GO TO (61,62,63),N1
2595 61 DO 72 K=1,4
2600 72 A(1,K)=S(1,K)
2605 GO TO 51
2610 62 DO 73 K=1,4
2615 73 A(1,K)=S(2,K)
2620 GO TO 51
2625 63 DO 74 K=1,4
2630 74 A(1,K)=S(3,K)
2635C  COMPUTE B-1 OPTION
2640 51 N2=((N-1-(20*(N1-1)))/5)+1
2645 GO TO (64,65,66,67),N2
2650 64 DO 75 K=1,4
2655 75 A(2,K)=S(4,K)
2660 GO TO 52
2665 65 DO 76 K=1,4
2670 76 A(2,K)=S(5,K)
2675 GO TO 52
2680 66 DO 77 K=1,4
2685 77 A(2,K)=S(6,K)
2690 GO TO 52
2695 67 DO 78 K=1,4
2700 78 A(2,K)=S(7,K)
2705C  COMPUTE SLBM OPTION
2710 52 N3=N-(20*(N1-1))-(5*(N2-1))
2715 GO TO (54,55,56,57,58),N3
2720 54 DO 44 K=1,4
2725 44 A(3,K)=S(8,K)
2730 GO TO 53
2735 55 DO 45 K=1,4
2740 45 A(3,K)=S(9,K)
2745 GO TO 53
2750 56 DO 46 K=1,4
2755 46 A(3,K)=S(10,K)
2760 GO TO 53
2765 57 DO 47 K=1,4
2770 47 A(3,K)=S(11,K)
2775 GO TO 53
2780 58 DO 48 K=1,4
```

```
2785 48 A(3,K)=S(12,K)
2790C
2795C  WRITE CURRENT OPTIONS TO FILE 'FSAIDOUT'
2800C
2805 53 WRITE (FSAIDOUT,5) N,(A(1,K),K=1,4),(A(2,K),K=1,4),
2810& (A(3,K),K=1,4)
2815 71 CONTINUE
2820C
2825 PRINT: "MASTER LIST HAS BEEN WRITTEN
2830& TO THE FILE FSAIDOUT"
2835 PRINT 3
2840 PRINT: "THE RESULTS MAY BE OBTAINED BY
2845& LISTING THAT FILE ON"
2850 PRINT: "THIS TELETYPE OR ON THE LINE PRINTER."
2855 PRINT 3
2999 94 STOP;END
```

APPENDIX B.3

COMPUTER PROGRAM - RDP

```
3000C  THIS PROGRAM IS CALLED  FSARDP.
3010C
3020C  THIS PROGRAM COMPUTES PRESENT FORCE R&D COST AND
3030C  SEFU FOR ALL 60 OPTIONS OF MIX OF CURRENT FORCE.
3040C  INPUT IS FROM FILES DESIGNATED FSARDC AND FSASEFU.
3050C  OUTPUT IS WRITTEN TO FILES DESIGNATED FSAOLDRD
3060C  AND FSAOLDS.
3070C
3080 FILENAME FSARDC,FSASEFU,FSAOLDRD,FSAOLDS
3090 REAL ORC(60,11),C1(3,10),C2(4,10),C3(5,10)
3100 INTEGER OS(60,10),S1(3,10),S2(4,10),S3(5,10)
3110 FSAOLDRD=8HFSAOLDRD;FSAOLDS=7HFSAOLDS
3120 FSARDC=6HFSARDC;FSASEFU=7HFSASEFU
3130C
3140 1 FORMAT (V)
3150 4 FORMAT (10F5.1,2X,F5.1)
3160 5 FORMAT (10I5,5X,I2)
3170 6 FORMAT (1H )
3180C
3190 READ (FSARDC,1) ((C1(I,L),L=1,10),I=1,3),
3200&  ((C2(J,L),L=1,10),J=1,4),((C3(K,L),L=1,10),K=1,5)
3210 READ (FSASEFU,1) ((S1(I,L),L=1,10),I=1,3),
3220&  ((S2(J,L),L=1,10),J=1,4),((S3(K,L),L=1,10),K=1,5)
3230C
3240   DO 30 I=1,3
3250     DO 30 J=1,4
3260     DO 30 K=1,5
3270 N=20*(I-1)+5*(J-1)+K
3280 ORC(N,11)=0.
3290     DO 40 L=1,10
3300 ORC(N,L)=C1(I,L)+C2(J,L)+C3(K,L)
3310 ORC(N,11)=ORC(N,11)+ORC(N,L)
3320 OS(N,L)=S1(I,L)+S2(J,L)+S3(K,L)
3330 40 CONTINUE
3340   WRITE (FSAOLDRD,4) (ORC(N,L),L=1,11)
3350     WRITE (FSAOLDS,5) (OS(N,L),L=1,10),N
3360 30 CONTINUE
3370 PRINT 6
3380 PRINT 6
3390   PRINT:"DATA WRITTEN ON FILES FSAOLDRD AND FSAOLDS"
3400 PRINT 6
3410 PRINT:"YOU ARE NOW READY TO RUN FSARDF"
3420 PRINT 6
3999 STOP;END
```

APPENDIX B.4

COMPUTER PROGRAM - RDF

```
4000C  THIS PROGRAM IS CALLED  FSARDF.
4005C
4010C  THIS PROGRAM COMPUTES R&D COST FIGURES FOR COMBINA-
4015C  TIONS OF A NEWLY PROPOSED SYSTEM (SS-1 OR B-2) AND
4020C  ALL COMBINATIONS OF CURRENT SYSTEMS (SM-1,B-1,SLBM)
4025C  BASED ON INITIAL CRITERIA OF QUANTITIES AND MINIMUM
4030C  SEFU REQUIREMENTS ESTABLISHED IN THE R&D TASK
4035C  (TASK 1).  INPUT IS FROM FILES FSAOLDS AND FSAOLDRD.
4040C  OUTPUT IS WRITTEN TO THE FILE RDSOLN.
4045C
4050 FILENAME FSAOLDRD, FSAOLDS, RDSOLN
4055 INTEGER TYPE, RDLENG, START, NO, SN
4060 INTEGER OS(60,10), SR(10), ASN(10), PS(10)
4065 REAL ORC(60,11), CRD(11), PRC(11)
4070 DATA SR/4*3000,3400,3700,2*4000,2*3500/
4075 FSAOLDS=7HFSAOLDS;FSAOLDRD=8HFSAOLDRD;RDSOLN=6HRDSOLN
4080 END FILE RDSOLN
4085C
4090 1 FORMAT(1H )
4095 2 FORMAT(10F5.1,2X,F5.1)
4100 3 FORMAT(10I5)
4105 4 FORMAT(1X)
4110 5 FORMAT(2HN=,I2,4X,5HTYPE=,I1,4X,9HSTART YR=,I1,
4115& 4X,7HLENGTH=,I1)
4120 6 FORMAT(33HTHIS DATA OUTPUT FILE IS  RDSOLN.//
4125& 42HTHE FOLLOWING CRITERIA HOLD FOR ALL SOLNS:/
4130& 31HTYPE 1 OR SS-1 HAS 300 VEHICLES/
4135& 31HTYPE 2 OR B-2  HAS 175 AIRCRAFT/
4140& 51HINVESTMENT PERIOD IS 3 YRS WITH 1 YR OVERLAP ON R&D
4145& /46HDATA BELOW ARE SOLN PARAMETERS, R&D COST, SEFU//)
4150C
4155C  HEADING FOR OUTPUT FILE AND INPUT DATA FOR
4160C  CURRENT FORCE STRUCTURE
4165C
4170 WRITE (RDSOLN,4)
4175 WRITE (RDSOLN,4)
4180 WRITE (RDSOLN,6)
4185 READ (FSAOLDRD,2)  ((ORC(N,I),I=1,11),N=1,60)
4190 READ (FSAOLDS,3)  ((OS(N,I),I=1,10),N=1,60)
4195C
4200C  ZERO REPEATED COMPUTING VARIABLES
4205C
4210 KNT=0
4215 11 KOUNT=0
4220 DO 12 I=1,10
4225 ASN(I)=0;PS(I)=0;CRD(I)=0.
4230 12 CONTINUE
4235 PRC(11)=0.
4240 PRINT 1
```

```
4245C
4250C  INPUT PARAMETERS
4255C
4260 PRINT !
4265 13 PRINT:"ENTER NEW SYSTEM DESIRED -
4270& 1 FOR SS-1  OR  2 FOR B-2"
4275 READ:TYPE
4280 PRINT !
4285 IF ((TYPE.EQ.1).OR.(TYPE.EQ.2)) GO TO 14
4290 PRINT:"INPUT ERROR, RETYPE"
4295 GO TO 13
4300 14 PRINT:"ENTER LENGTH OF RESEARCH (IN YRS): 3,4, OR 5"
4305 READ:RDLENG
4310 PRINT !
4315 IF((RDLENG.EQ.3).OR.(RDLENG.EQ.4)
4320& .OR.(RDLENG.EQ.5)) GO TO 15
4325 PRINT:"INPUT ERROR, RETYPE"
4330 GO TO 14
4335 15 PRINT:"ENTER YEAR IN WHICH R&D IS TO START"
4340 READ:START
4345 PRINT !
4350 IF (START.LT.6) GO TO 16
4355 PRINT:"START TIME TOO LATE, SHOULD BE <6, RETYPE"
4360 GO TO 15
4365C
4370C  ESTABLISH TOTAL R&D COST
4375C
4380 16 IF (TYPE.EQ.2) GO TO 17
4385 RD=18.;NO=300
4390 GO TO 18
4395 17 RD=8.;NO=175
4400C
4405C  COMPUTE ANNUAL R&D COSTS
4410C
4415 18 GO TO (25,25,21,22,23),RDLENG
4420 21 RD=1.5 * RD
4425 CRD(START)=RD/3.;CRD(START+1)=RD/3.;CRD(START+2)=RD/3.
4430 GO TO 25
4435 22 CRD(START)=RD/4.;CRD(START+1)=RD/4.
4440 CRD(START+2)=RD/4.;CRD(START+3)=RD/4.
4445 GO TO 25
4450 23 RD=.8 * RD;CRD(START)=RD/5.;CRD(START+1)=RD/5.
4455 CRD(START+2)=RD/5.;CRD(START+3)=RD/5.;CRD(START+4)=RD/5.
4460C
4465C  COMPUTE TOTAL SEFU CONTRIBUTIONS
4470C
4475 25 IF (TYPE.EQ.1) GO TO 39
4480C
4485C  SEFU FOR B-2
4490C
4495 IF (NO.GT.75) GO TO 31
4500 SN=13.33333333*NO
4505 GO TO 49
4510 31 IF (NO.GT.125) GO TO 32
```

```
4515 SN=12*NO+100
4520 GO TO 49
4525 32 IF (NO.GT.175) GO TO 33
4530 SN=8*NO+600
4535 GO TO 49
4540 33 IF (NO.GT.225) GO TO 34
4545 SN=4*NO+1300
4550 GO TO 49
4555 34 SN=.2857143*NO+2135.714
4560 GO TO 49
4565C
4570C  SEFU FOR SS-1
4575C
4580  39 IF (NO.GT.100) GO TO 41
4585 SN=NO
4590 GO TO 49
4595 41 IF (NO.GT.175) GO TO 42
4600 SN=3.666667*NO-266.6667
4605 GO TO 49
4610 42 IF (NO.GT.240) GO TO 43
4615 SN=9.615385*NO-1307.692
4620 GO TO 49
4625 43 IF (NO.GT.275) GO TO 44
4630 SN=21.42857*NO-4142.857
4635 GO TO 49
4640 44 IF (NO.GT.325) GO TO 45
4645 SN=10*NO-1000
4650 GO TO 49
4655 45 SN=3.333333*NO+1166.667
4660C
4665C
4670C  COMPUTE ANNUAL SEFU CONTRIBUTIONS
4675C
4680 49 KK=RDLENG + START -1
4685 GO TO (61,61,61,61,61,61,61,62,63,64),KK
4690 61 ASN(KK+3)=SN
4695 62 ASN(KK+2)=2.*SN/3.
4700 63 ASN(KK+1)=SN/3.
4705 64 KY=1;K=KK+4
4710 KY=1;K=KK+4
4715 DO 51 KS=K,10
4720 IF (K.GT.10) GO TO 51
4725 ASN(KS)=SN-(KY*.05*SN)
4730 KY=KY+1
4735 51 CONTINUE
4740C
4745C  COMPARE SEFU AGAINST MINIMUM REQUIREMENTS
4750C
4755 DO 54 N=1,60
4760 DO 52 I=1,10
4765 PRC(I)=CRD(I)+ORC(N,I);PS(I)=ASN(I)+OS(N,I)
4770 52 CONTINUE
4775 PRC(11)=ORC(N,11)+RD
4780 DO 53 I=1,10
```

```
4785 IF(PS(I).LT.SR(I)) GO TO 54
4790 53 CONTINUE
4795C
4800C  WRITE SOLUTIONS TO FILE
4805C
4810 WRITE (RDSOLN,4)
4815 WRITE (RDSOLN,5) N,TYPE,START,RDLENG
4820 WRITE (RDSOLN,2) (PRC(I),I=1,11)
4825 WRITE (RDSOLN,3) (PS(I),I=1,10)
4830 KOUNT=KOUNT+1
4835 54 CONTINUE
4840 KNT=KNT+KOUNT
4845C
4850C  REPETITION SEQUENCE
4855C
4860 PRINT !
4865 PRINT:"NUMBER OF FEASIBLE SOLUTIONS FOR THESE
4870& PARAMETERS = ",KOUNT
4875 PRINT !
4880 55 PRINT:"DO YOU HAVE ANOTHER PROBLEM?  1=YES, 0=NO"
4885 READ:L
4890 IF ((L.EQ.1).OR.(L.EQ.0)) GO TO 56
4895 PRINT !
4900 PRINT:"INPUT ERROR, RETYPE"
4905 GO TO 55
4910 56 IF (L.EQ.1) GO TO 11
4915 PRINT !
4920 PRINT:"TOTAL NUMBER OF FEASIBLE SOLUTIONS ON FILE
4925& RDSOLN = ",KNT
4930 PRINT !
4935 PRINT:"SOLUTIONS MAY BE OBTAINED BY 'LIST RDSOLN'"
4999 STOP;END
```

APPENDIX B.5

COMPUTER PROGRAM - PRES

```
5000C  THIS PROGRAM IS CALLED  FSAPRES.
5010C
5020C  THIS PROGRAM COMPUTES PRESENT FORCE COST AND SEFU
5030C  FOR ALL 60 OPTIONS OF MIX OF CURRENT FORCES.  INPUT
5040C  IS FROM FILES DESIGNATED FSACOST AND FSASEFU.  OUTPUT
5050C  IS WRITTEN TO FILES DESIGNATED FSAOLDC AND FSAOLDS.
5060C
5070 FILENAME FSACOST,FSASEFU,FSAOLDC,FSAOLDS
5080 REAL OC(60,11),C1(3,10),C2(4,10),C3(5,10)
5090 INTEGER OS(60,10),S1(3,10),S2(4,10),S3(5,10)
5100 FSAOLDC=7HFSAOLDC;FSAOLDS=7HFSAOLDS
5110 FSACOST=7HFSACOST;FSASEFU=7HFSASEFU
5120C
5130 1 FORMAT (V)
5140 4 FORMAT (10F5.1,2X,F5.1)
5150 5 FORMAT (10I5,5X,I2)
5160 6 FORMAT (1H )
5170C
5180 READ (FSACOST,1) ((C1(I,L),L=1,10),I=1,3),
5190&  ((C2(J,L),L=1,10),J=1,4),((C3(K,L),L=1,10),K=1,5)
5200 READ (FSASEFU,1) ((S1(I,L),L=1,10),I=1,3),
5210&  ((S2(J,L),L=1,10),J=1,4),((S3(K,L),L=1,10),K=1,5)
5220C
5230  DO 30 I=1,3
5240    DO 30 J=1,4
5250    DO 30 K=1,5
5260 N=20*(I-1)+5*(J-1)+K
5270 OC(N,11)=0.
5280    DO 40 L=1,10
5290 OC(N,L)=C1(I,L)+C2(J,L)+C3(K,L)
5300 OC(N,11)=OC(N,11)+OC(N,L)
5310 OS(N,L)=S1(I,L)+S2(J,L)+S3(K,L)
5320 40 CONTINUE
5330  WRITE (FSAOLDC,4) (OC(N,L),L=1,11)
5340    WRITE (FSAOLDS,5) (OS(N,L),L=1,10),N
5350 30 CONTINUE
5360 PRINT 6
5370 PRINT 6
5380  PRINT:"DATA WRITTEN ON FILES FSAOLDC AND FSAOLDS"
5390 PRINT 6
5400 PRINT:"YOU ARE NOW READY TO RUN FSAFORCE"
5410 PRINT 6
5999 STOP;END
```

APPENDIX B.6

COMPUTER PROGRAM - FORCE

```
6000C  THIS PROGRAM IS CALLED  FSAFORCE.
6002C
6004C  FOR A DESCRIPTION OF THE FUNCTION AND
6006C  OPERATION OF FSAFORCE, SEE FSATEACH.
6008C
6010 FILENAME FSAOLDC,FSAOLDS,SOLN
6012 INTEGER TYPE,RDLENG,START,INVT,OL,NO,SN
6014 INTEGER OS(60,10),SR(10),ASN(10),PS(10)
6016 REAL OC(60,11),BUD(10),CRD(10),ACI(10)
6018 REAL COP(10),NC(11),PC(11),CI,UCOP
6020C
6022 1 FORMAT (1H )
6024 2 FORMAT (10F5.1,2X,F5.1)
6026 3 FORMAT (10I5,7X)
6028 4 FORMAT ("THIS DATA OUTPUT FILE IS  SOLN."//
6030& "FIRST DATA LISTED ARE THE CRITERIA FOR BUDGET
6032& AND"/"SEFU WHICH YOU INPUT.  THEN ALL FEASIBLE
6034& FORCE"/"OPTIONS FOR YOUR INPUT PARAMETERS FOR
6036& THE NEW SYSTEM"/"ARE LISTED.  THE PARAMETERS
6038& ARE N (CURRENT FORCE"/"OPTION), TYPE (WHICH NEW
6040& SYSTEM?), START (YEAR IN WHICH"/"R&D IS TO START),
6042& R&D LENGTH, INVESTMENT LENGTH,"/"OVERLAP PERIOD,
6044& AND QUANTITY OF NEW SYSTEM DESIRED."///)
6046 5 FORMAT (1X,/,2HN=,I2,5X,5HTYPE=,I1,4X,6HSTART=,
6048& I1,4X,11HR&D LENGTH=,I1,/,14HINVEST LENGTH=,
6050& I1,3X,8HOVERLAP=,I1,3X,9HQUANTITY=,I3)
6052 6 FORMAT (10I5)
6054 7 FORMAT (1X//"MAXIMUM BUDGET CRITERIA"/
6056& 10F5.1,/,"MINIMUM SEFU CRITERIA",/,10I5//)
6058C
6060C  READ OLD SYSTEM INPUTS & WRITE HEADER TO FILE
6062C
6064 FSAOLDC=7HFSAOLDC;FSAOLDS=7HFSAOLDS;SOLN=4HSOLN
6066 END FILE SOLN
6068 READ (FSAOLDC,2) ((OC(N,I),I=1,11),N=1,60)
6070 READ (FSAOLDS,3) ((OS(N,I),I=1,10),N=1,60)
6072 WRITE (SOLN,4)
6074C
6076C  ENTER COMPARISON CRITERIA
6078C
6080 KNT=0
6082 101 PRINT 1
6084 PRINT: "ENTER BUDGET CEILING IN BILLIONS OF $
6086& FOR EACH YEAR (10 VALUES)"
6088 READ: (BUD(I),I=1,10)
6090 PRINT 1
6092 PRINT: "ENTER MINIMUM SEFU REQUIREMENT FOR EACH
6094& OF THE TEN YEARS (10 VALUES)"
6096 READ: (SR(I),I=1,10)
```

```
6098 WRITE (SOLN,7) (BUD(I),I=1,10),(SR(I),I=1,10)
6100C
6102C  ENTER NEW SYSTEM PARAMETERS
6104C
6106 102 PRINT 1
6108 KOUNT=0
6110 103 PRINT: "ENTER NEW SYSTEM DESIRED -
6112& 1 FOR SS-1,  2 FOR B-2"
6114 READ: TYPE
6116 PRINT 1
6118 IF ((TYPE.EQ.1).OR.(TYPE.EQ.2)) GO TO 104
6120 PRINT: "INPUT ERROR, RETYPE"
6122 GO TO 103
6124 104 PRINT: "ENTER LENGTH OF RESEARCH (IN YRS) -
6126& 3, 4, OR 5"
6128 READ: RDLENG
6130 PRINT 1
6132 IF ((RDLENG.EQ.3).OR.(RDLENG.EQ.4).OR.
6134& (RDLENG.EQ.5)) GO TO 105
6136 PRINT: "INPUT ERROR, RETYPE"
6138 GO TO 104
6140 105 PRINT: "YEAR IN WHICH R&D IS TO START"
6142 READ: START
6144 PRINT 1
6146 IF (START.LT.6) GO TO 106
6148 PRINT: "START TIME TOO LATE, SHOULD BE <6, RETYPE"
6150 GO TO 105
6152 106 PRINT: "ENTER LENGTH OF INVESTMENT PERIOD
6154& (IN YRS) - 2, 3, OR 4"
6156 READ: INVT
6158 PRINT 1
6160 IF ((INVT.EQ.2).OR.(INVT.EQ.3).OR.
6162& (INVT.EQ.4)) GO TO 107
6164 PRINT: "INPUT ERROR, RETYPE"
6166 GO TO 106
6168 107 PRINT: "ENTER R&D AND INVESTMENT OVERLAP TIME
6170& (IN YRS) - 1 OR 0"
6172 READ: OL
6174 PRINT 1
6176 IF ((OL.EQ.1).OR.(OL.EQ.0)) GO TO 108
6178 PRINT: "INPUT ERROR, RETYPE"
6180 GO TO 107
6182 108 PRINT: "ENTER SMALLEST AND LARGEST NUMBER
6184& OF UNITS OF NEW"
6186 PRINT: "SYSTEM TO BE CONSIDERED (PROGRAM STEPS
6188& THROUGH THIS RANGE"
6190 PRINT: "IN INCREMENTS OF FIVE UNITS)"
6192 READ: NO1,NO2
6194 PRINT 1
6196C  ZERO REPEATED COMPUTATION FIELD
6198 DO 109 I=1,10
6200 CRD(I)=0.
6202 109 CONTINUE
6204C
```

```
6206C  SET R&D COST & UNIT OPERATING COST
6208C
6210 IF (TYPE.EQ.2) GO TO 110
6212 RD=18.;UCOP=.020
6214 GO TO 111
6216 110 RD=8.;UCOP=.050
6218C
6220C  COMPUTE NEW SYSTEM ANNUAL R&D COSTS
6222C
6224 111 GO TO (115,115,112,113,114),RDLENG
6226 112 RD=1.5*RD
6228 CRD(START)=RD/3;CRD(START+1)=RD/3;CRD(START+2)=RD/3
6230 GO TO 115
6232 113 CRD(START)=RD/4;CRD(START+1)=RD/4
6234 CRD(START+2)=RD/4;CRD(START+3)=RD/4
6236 GO TO 115
6238 114 RD=.8*RD;CRD(START)=RD/5
6240 CRD(START+1)=RD/5;CRD(START+2)=RD/5
6242 CRD(START+3)=RD/5;CRD(START+4)=RD/5
6244C
6246C  START NEW SYSTEM INVESTMENT COST & SEFU COMPUTATIONS
6248C
6250C  NOTE:  QUANTITY STEP IF FIVE
6252C
6254 115 DO 154 NO=NO1,NO2,5
6256C  ZERO REPEATED COMPUTATION FIELDS
6258 DO 116 I=1,10
6260 ACI(I)=0;COP(I)=0;ASN(I)=0
6262 116 CONTINUE
6264C  INVESTMENT COST & SEFU FOR B-2
6266 IF (TYPE.EQ.1) GO TO 121
6268 CI=(1/(.0064078+2.54831E-05*NO))*NO/1000
6270 IF (NO.GT.75) GO TO 117
6272 SN=13.33333333*NO
6274 GO TO 127
6276 117 IF (NO.GT.125) GO TO 118
6278 SN=12*NO+100
6280 GO TO 127
6282 118 IF (NO.GT.175) GO TO 119
6284 SN=8*NO+600
6286 GO TO 127
6288 119 IF (NO.GT.225) GO TO 120
6290 SN=4*NO+1300
6292 GO TO 127
6294 120 SN=.2857143*NO+2135.714
6296 GO TO 127
6298C  INVESTMENT COST & SEFU FOR SS-1
6300 121 CI=(229.6644*EXP(-.0023368*NO))*NO/1000
6302 IF (NO.GT.100) GO TO 122
6304 SN=NO
6306 GO TO 127
6308 122 IF (NO.GT.175) GO TO 123
6310 SN=3.66666667*KNO-266.66666667
6312 GO TO 127
```

```
6314 123 IF (NO.GT.240) GO TO 124
6316 SN=9.615385*NO-1307.692
6318 GO TO 127
6320 124 IF (NO.GT.275) GO TO 125
6322 SN=21.42857*NO-4142.857
6324 GO TO 127
6326 125 IF (NO.GT.325) GO TO 126
6328 SN=10*NO-1000
6330 GO TO 127
6332 126 SN=3.33333333*NO+1166.66666667
6334 127 IF (OL.EQ.1) GO TO 128
6336C
6338C  START COMPUTATION OF ANNUAL INVESTMENT COSTS,
6340C  OPERATING COSTS, & SEFU FOR NEW SYSTEM.
6342C
6344 KK=RDLENG+START
6346 GO TO 129
6348 128 KK=RDLENG+START-1
6350 129 GO TO (149,130,131,132),INVT
6352 130 CI=1.25*CI
6354 GO TO (134,134,134,134,134,134,134,134,135,136),KK
6356 134 ASN(KK+2)=SN;COP(KK+2)=NO*UCOP
6358 135 ASN(KK+1)=.5*SN;COP(KK+1)=.5*NO*UCOP
6360 ACI(KK+1)=.5*CI
6362 136 ACI(KK)=.5*CI
6364 KY=1;K=KK+3
6366 IF (K.GT.10) GO TO 149
6368 DO 137 KS=K,10
6370 ASN(KS)=SN-(KY*.05*SN);COP(KS)=NO*UCOP
6372 KY=KY+1
6374 137 CONTINUE
6376 GO TO 149
6378 131 GO TO (138,138,138,138,138,138,138,139,140,141),KK
6380 138 ASN(KK+3)=SN;COP(KK+3)=NO*UCOP
6382 139 ASN(KK+2)=2*SN/3;COP(KK+2)=2*NO*UCOP/3
6384 ACI(KK+2)=CI/3
6386 140 ASN(KK+1)=SN/3;COP(KK+1)=NO*UCOP/3
6388 ACI(KK+1)=CI/3
6390 141 ACI(KK)=CI/3
6392 KY=1;K=KK+4
6394 IF (K.GT.10) GO TO 149
6396 DO 142 KS=K,10
6398 ASN(KS)=SN-(KY*.05*SN);COP(KS)=NO*UCOP
6400 KY=KY+1
6402 142 CONTINUE
6404 GO TO 149
6406 132 CI=.9*CI
6408 GO TO (143,143,143,143,143,143,144,145,146,147),KK
6410 143 ASN(KK+4)=SN;COP(KK+4)=NO*UCOP
6412 144 ASN(KK+3)=.75*SN;COP(KK+3)=.75*NO*UCOP
6414 ACI(KK+3)=CI/4
6416 145 ASN(KK+2)=.5*SN;COP(KK+2)=.5*NO*UCOP
6418 ACI(KK+2)=CI/4
6420 146 ASN(KK+1)=.25*SN;COP(KK+1)=.25*NO*UCOP
```

```
6422 ACI(KK+1)=CI/4
6424 147 ACI(KK)=CI/4
6426 KY=1;K=KK+5
6428 IF (K.GT.10) GO TO 149
6430 DO 148 KS=K,10
6432 ASN(KS)=SN-(KY*.05*SN);COP(KS)=NO*UCOP
6434 KY=KY+1
6436 148 CONTINUE
6438C  ZERO REPEATED COMPUTATION FIELDS
6440 149 DO 150 I=1,10
6442 NC(I)=0;PC(I)=0;PS(I)=0
6444 150 CONTINUE
6446 NC(11)=0;PC(11)=0
6448C  COMPUTE NEW SYSTEM TOTAL COST
6450 DO 151 KC=1,10
6452 NC(KC)=CRD(KC)+ACI(KC)+COP(KC)
6454 NC(11)=NC(11)+NC(KC)
6456 151 CONTINUE
6458C
6460C  START COMPUTATION OF OLD + NEW (TOTAL)
6462C  SYSTEMS COSTS & SEFUS
6464C
6466 DO 154 N=1,60
6468 DO 152 I=1,10
6470 PC(I)=NC(I)+OC(N,I)
6472 PS(I)=ASN(I)+OS(N,I)
6474 152 CONTINUE
6476 PC(11)=NC(11)+OC(N,11)
6478C
6480C  COMPARISON OF TOTAL SYSTEMS COSTS & SEFUS
6482C  AGAINST INPUT CRITERIA
6484C
6486 DO 153 I=1,10
6488 IF (PC(I).GT.BUD(I)) GO TO 154
6490 IF (PS(I).LT.SR(I)) GO TO 154
6492 153 CONTINUE
6494C  WRITE FEASIBLE SOLUTIONS TO FILE
6496 WRITE (SOLN,5) N,TYPE,START,RDLENG,INVT,OL,NO
6498 WRITE (SOLN,2) (PC(I),I=1,11)
6500 WRITE (SOLN,6) (PS(I),I=1,10)
6502 KOUNT=KOUNT+1
6504 154 CONTINUE
6506 KNT=KNT+KOUNT
6508 PRINT !
6510 PRINT: "NUMBER OF FEASIBLE SOLUTIONS FOR
6512& THESE PARAMETERS =",KOUNT
6514 PRINT !
6516C
6518C  RETETITION SEQUENCE
6520C
6522 155 PRINT: "DO YOU HAVE ANOTHER SYSTEM FOR THE
6524& SAME BUDGET/SEFU"
6526 PRINT: "CRITERIA?  1 FOR YES, 0 FOR NO"
6528 READ: ITEST
```

```
6530 PRINT !
6532 IF ((ITEST.EQ.1).OR.(ITEST.EQ.Ø)) GO TO 156
6534 PRINT: "INPUT ERROR, RETYPE"
6536 GO TO 155
6538 156 IF (ITEST.EQ.1) GO TO 102
6540 157 PRINT: "DO YOU HAVE NEW COMPARISON CRITERIA?
6542&  1 FOR YES, Ø FOR NO"
6544 READ: ITESTA
6546 PRINT !
6548 IF ((ITESTA.EQ.1).OR.(ITESTA.EQ.Ø)) GO TO 158
6550 PRINT: "INPUT ERROR, RETYPE"
6552 GO TO 157
6554 158 PRINT !
6556 IF (ITESTA.EQ.1) GO TO 101
6558 PRINT: "TOTAL NUMBER OF FEASIBLE SOLUTIONS ON
6560& FILE SOLN =",KNT
6562 PRINT !
6564 PRINT: "SOLUTIONS MAY BE OBTAINED BY 'LIST SOLN'"
6566 PRINT !
6999 STOP;END
```

APPENDIX C

COMPUTER DATA FILES

C.1 IDOUT
C.2 SEFU
C.3 RDC
C.4 COST
C.5 OLDS
C.6 OLDRD
C.7 OLDC
C.8 RDSOLN
C.9 SOLN

APPENDIX C.1

DATA FILE - IDOUT

THIS OUTPUT IDENTIFIES THE CURRENT FORCE STRUCTURE OPTIONS

N	SM-1	B-1	SLBM
1	5 YR PHASE OUT	600 NORMAL	PRESENT
2	5 YR PHASE OUT	600 NORMAL	PHASE OUT
3	5 YR PHASE OUT	600 NORMAL	NO MOD
4	5 YR PHASE OUT	600 NORMAL	CONTRACT MOD
5	5 YR PHASE OUT	600 NORMAL	EXTEND MOD
6	5 YR PHASE OUT	600 EXTENSION	PRESENT
7	5 YR PHASE OUT	600 EXTENSION	PHASE OUT
8	5 YR PHASE OUT	600 EXTENSION	NO MOD
9	5 YR PHASE OUT	600 EXTENSION	CONTRACT MOD
10	5 YR PHASE OUT	600 EXTENSION	EXTEND MOD
11	5 YR PHASE OUT	600 CONTRACTION	PRESENT
12	5 YR PHASE OUT	600 CONTRACTION	PHASE OUT
13	5 YR PHASE OUT	600 CONTRACTION	NO MOD
14	5 YR PHASE OUT	600 CONTRACTION	CONTRACT MOD
15	5 YR PHASE OUT	600 CONTRACTION	EXTEND MOD
16	5 YR PHASE OUT	400 TERMINATION	PRESENT
17	5 YR PHASE OUT	400 TERMINATION	PHASE OUT
18	5 YR PHASE OUT	400 TERMINATION	NO MOD
19	5 YR PHASE OUT	400 TERMINATION	CONTRACT MOD
20	5 YR PHASE OUT	400 TERMINATION	EXTEND MOD
21	4 YR PHASE OUT	600 NORMAL	PRESENT
22	4 YR PHASE OUT	600 NORMAL	PHASE OUT
23	4 YR PHASE OUT	600 NORMAL	NO MOD
24	4 YR PHASE OUT	600 NORMAL	CONTRACT MOD
25	4 YR PHASE OUT	600 NORMAL	EXTEND MOD
26	4 YR PHASE OUT	600 EXTENSION	PRESENT
27	4 YR PHASE OUT	600 EXTENSION	PHASE OUT
28	4 YR PHASE OUT	600 EXTENSION	NO MOD
29	4 YR PHASE OUT	600 EXTENSION	CONTRACT MOD
30	4 YR PHASE OUT	600 EXTENSION	EXTEND MOD

31	4 YR PHASE OUT	600	CONTRACTION	PRESENT
32	4 YR PHASE OUT	600	CONTRACTION	PHASE OUT
33	4 YR PHASE OUT	600	CONTRACTION	NO MOD
34	4 YR PHASE OUT	600	CONTRACTION	CONTRACT MOD
35	4 YR PHASE OUT	600	CONTRACTION	EXTEND MOD
36	4 YR PHASE OUT	400	TERMINATION	PRESENT
37	4 YR PHASE OUT	400	TERMINATION	PHASE OUT
38	4 YR PHASE OUT	400	TERMINATION	NO MOD
39	4 YR PHASE OUT	400	TERMINATION	CONTRACT MOD
40	4 YR PHASE OUT	400	TERMINATION	EXTEND MOD
41	3 YR PHASE OUT	600	NORMAL	PRESENT
42	3 YR PHASE OUT	600	NORMAL	PHASE OUT
43	3 YR PHASE OUT	600	NORMAL	NO MOD
44	3 YR PHASE OUT	600	NORMAL	CONTRACT MOD
45	3 YR PHASE OUT	600	NORMAL	EXTEND MOD
46	3 YR PHASE OUT	600	EXTENSION	PRESENT
47	3 YR PHASE OUT	600	EXTENSION	PHASE OUT
48	3 YR PHASE OUT	600	EXTENSION	NO MOD
49	3 YR PHASE OUT	600	EXTENSION	CONTRACT MOD
50	3 YR PHASE OUT	600	EXTENSION	EXTEND MOD
51	3 YR PHASE OUT	600	CONTRACTION	PRESENT
52	3 YR PHASE OUT	600	CONTRACTION	PHASE OUT
53	3 YR PHASE OUT	600	CONTRACTION	NO MOD
54	3 YR PHASE OUT	600	CONTRACTION	CONTRACT MOD
55	3 YR PHASE OUT	600	CONTRACTION	EXTEND MOD
56	3 YR PHASE OUT	400	TERMINATION	PRESENT
57	3 YR PHASE OUT	400	TERMINATION	PHASE OUT
58	3 YR PHASE OUT	400	TERMINATION	NO MOD
59	3 YR PHASE OUT	400	TERMINATION	CONTRACT MOD
60	3 YR PHASE OUT	400	TERMINATION	EXTEND MOD

APPENDIX C.2

DATA FILE - SEFU

```
800,700,450,400,150,0,0,0,0,0
700,400,200,50,0,0,0,0,0,0
500,100,25,0,0,0,0,0,0,0
1000,1300,1700,1700,1650,1600,1500,1400,1300,1200
1000,1150,1400,1700,1650,1600,1500,1400,1300,1200
1000,1400,1700,1700,1650,1600,1500,1400,1300,1200
1000,1250,1300,1350,1300,1250,1200,1150,1100,1050
1200,1150,1050,1200,1350,1500,1400,1300,1200,1100
1100,900,350,100,0,0,0,0,0,0
1200,1150,1050,900,800,700,600,500,200,100
1200,1150,1400,1550,1700,1600,1500,1400,1300,1200
1200,1150,1050,950,1000,1200,1400,1300,1200,1100
```

THIS DATA FILE IS CALLED FSASEFU.

THIS FILE CONTAINS THE SEFU INPUT DATA FOR THE CURRENTLY AVAILABLE FORCE STRUCTURE OPTIONS. IT PROVIDES INPUT FOR THE PROGRAM FSAPRES.

APPENDIX C.3

DATA FILE - RDC

```
0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0
1.5,0,0,0,0,0,0,0,0,0
1.5,0,0,0,0,0,0,0,0,0
1.5,0,0,0,0,0,0,0,0,0
1.5,0,0,0,0,0,0,0,0,0
1,1,1,0,0,0,0,0,0,0
3.5,0,0,0,0,0,0,0,0,0
3.5,0,0,0,0,0,0,0,0,0
2,2,0,0,0,0,0,0,0,0
.6,.6,.6,.6,0,0,0,0,0,0
```

THIS DATA FILE IS CALLED FSARDC.

THIS DATA FILE CONTAINS THE R&D COST INPUT DATA FOR THE CURRENTLY AVAILABLE FORCE STRUCTURE OPTIONS. IT PROVIDES INPUT FOR THE PROGRAM FSARDP.

APPENDIX C.4

DATA FILE - COST

```
5.8,5.2,4.8,3.2,2.4,0,0,0,0,0
4.5,4,3.3,2,0,0,0,0,0,0
5.7,4,2.5,0,0,0,0,0,0,0
8.5,10,13,9,9,9,9,9,9,9
7,7.8,10,11.5,9,9,9,9,9,9
14.5,18,9,9,9,9,9,9,9,9
8,9.5,6,6,6,6,6,6,6,6
8,8,10,7,7,5,5,5,5,5
8.5,4.5,4,1,0,0,0,0,0,0
8.5,5,5,5,5,5,5,5,4,2.5
9,11.5,8,7,5,5,5,5,5,5
7.6,7.6,7.6,11.1,9.5,5,5,5,5,5
```

THIS DATA FILE IS CALLED FSACOST

THIS FILE CONTAINS THE COST INPUT DATA FOR THE CURRENTLY AVAILABLE FORCE STRUCTURE OPTIONS. IT PROVIDES INPUT FOR THE PROGRAM 'FSAPRES'.

APPENDIX C.5

DATA FILE - OLDS

3000	3150	3200	3300	3150	3100	2900	2700	2500	2300	1
2900	2900	2500	2200	1800	1600	1500	1400	1300	1200	2
3000	3150	3200	3000	2600	2300	2100	1900	1500	1300	3
3000	3150	3550	3650	3500	3200	3000	2800	2600	2400	4
3000	3150	3200	3050	2800	2800	2900	2700	2500	2300	5
3000	3000	2900	3300	3150	3100	2900	2700	2500	2300	6
2900	2750	2200	2200	1800	1600	1500	1400	1300	1200	7
3000	3000	2900	3000	2600	2300	2100	1900	1500	1300	8
3000	3000	3250	3650	3500	3200	3000	2800	2600	2400	9
3000	3000	2900	3050	2800	2800	2900	2700	2500	2300	10
3000	3250	3200	3300	3150	3100	2900	2700	2500	2300	11
2900	3000	2500	2200	1800	1600	1500	1400	1300	1200	12
3000	3250	3200	3000	2600	2300	2100	1900	1500	1300	13
3000	3250	3550	3650	3500	3200	3000	2800	2600	2400	14
3000	3250	3200	3050	2800	2800	2900	2700	2500	2300	15
3000	3100	2800	2950	2800	2750	2600	2450	2300	2150	16
2900	2850	2100	1850	1450	1250	1200	1150	1100	1050	17
3000	3100	2800	2650	2250	1950	1800	1650	1300	1150	18
3000	3100	3150	3300	3150	2850	2700	2550	2400	2250	19
3000	3100	2800	2700	2450	2450	2600	2450	2300	2150	20
2900	2850	2950	2950	3000	3100	2900	2700	2500	2300	21
2800	2600	2250	1850	1650	1600	1500	1400	1300	1200	22
2900	2850	2950	2650	2450	2300	2100	1900	1500	1300	23
2900	2850	3300	3300	3350	3200	3000	2800	2600	2400	24
2900	2850	2950	2700	2650	2800	2900	2700	2500	2300	25
2900	2700	2650	2950	3000	3100	2900	2700	2500	2300	26
2800	2450	1950	1850	1650	1600	1500	1400	1300	1200	27
2900	2700	2650	2650	2450	2300	2100	1900	1500	1300	28
2900	2700	3000	3300	3350	3200	3000	2800	2600	2400	29
2900	2700	2650	2700	2650	2800	2900	2700	2500	2300	30
2900	2950	2950	2950	3000	3100	2900	2700	2500	2300	31
2800	2700	2250	1850	1650	1600	1500	1400	1300	1200	32
2900	2950	2950	2650	2450	2300	2100	1900	1500	1300	33
2900	2950	3300	3300	3350	3200	3000	2800	2600	2400	34
2900	2950	2950	2700	2650	2800	2900	2700	2500	2300	35
2900	2800	2550	2600	2650	2750	2600	2450	2300	2150	36
2800	2550	1850	1500	1300	1250	1200	1150	1100	1050	37
2900	2800	2550	2300	2100	1950	1800	1650	1300	1150	38
2900	2800	2900	2950	3000	2850	2700	2550	2400	2250	39
2900	2800	2550	2350	2300	2450	2600	2450	2300	2150	40
2700	2550	2775	2900	3000	3100	2900	2700	2500	2300	41
2600	2300	2075	1800	1650	1600	1500	1400	1300	1200	42
2700	2550	2775	2600	2450	2300	2100	1900	1500	1300	43
2700	2550	3125	3250	3350	3200	3000	2800	2600	2400	44
2700	2550	2775	2650	2650	2800	2900	2700	2500	2300	45
2700	2400	2475	2900	3000	3100	2900	2700	2500	2300	46
2600	2150	1775	1300	1650	1600	1500	1400	1300	1200	47
2700	2400	2475	2600	2450	2300	2100	1900	1500	1300	48
2700	2400	2825	3250	3350	3200	3000	2800	2600	2400	49

2700	2400	2475	2650	2650	2800	2900	2700	2500	2300	50
2700	2650	2775	2900	3000	3100	2900	2700	2500	2300	51
2600	2400	2075	1800	1650	1600	1500	1400	1300	1200	52
2700	2650	2775	2600	2450	2300	2100	1900	1500	1300	53
2700	2650	3125	3250	3350	3200	3000	2800	2600	2400	54
2700	2650	2775	2650	2650	2800	2900	2700	2500	2300	55
2700	2500	2375	2550	2650	2750	2600	2450	2300	2150	56
2600	2250	1675	1450	1300	1250	1200	1150	1100	1050	57
2700	2500	2375	2250	2100	1950	1800	1650	1300	1150	58
2700	2500	2725	2900	3000	2850	2700	2550	2400	2250	59
2700	2500	2375	2300	2300	2450	2600	2450	2300	2150	60

THIS DATA FILE IS CALLED FSAOLDS.

THIS DATA FILE CONTAINS THE SEFU OUTPUT DATA FROM THE PROGRAM FSAPRES. FSAPRES COMPUTES THE TOTAL COST FOR ALL POSSIBLE COMBINATIONS OF THE CURRENT FORCE OPTIONS (SM-1, B-1, SLBM). THIS DATA IS THEN USED AS COST INPUT DATA FOR THE PROGRAM FSAFORCE.

APPENDIX C.6

DATA FILE - OLDRD

2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5

2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9
2.5	1.0	1.0	0.	0.	0.	0.	0.	0.	0.	4.5
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.0
3.5	2.0	0.	0.	0.	0.	0.	0.	0.	0.	5.5
2.1	0.6	0.6	0.6	0.	0.	0.	0.	0.	0.	3.9

THIS DATA FILE IS CALLED FSAOLDRD.

THIS DATA FILE CONTAINS THE R&D COST OUTPUT DATA FROM THE PROGRAM FSARDP. FSARDP COMPUTES THE TOTAL R&D COST FOR ALL POSSIBLE COMBINATIONS OF THE CURRENT FORCE OPTIONS (SM-1, B-1, SLBM). THIS DATA IS THEN USED AS R&D COST INPUT DATA FOR THE PROGRAM FSARDF.

APPENDIX C.7

DATA FILE - OLDC

22.3	23.2	27.8	19.2	18.4	14.0	14.0	14.0	14.0	14.0	180.9
22.8	19.7	21.8	13.2	11.4	9.0	9.0	9.0	9.0	9.0	133.9
22.8	20.2	22.8	17.2	16.4	14.0	14.0	14.0	13.0	11.5	165.9
23.3	26.7	25.8	19.2	16.4	14.0	14.0	14.0	14.0	14.0	181.4
21.9	22.8	25.4	23.3	20.9	14.0	14.0	14.0	14.0	14.0	184.3
20.8	21.0	24.8	21.7	18.4	14.0	14.0	14.0	14.0	14.0	176.7
21.3	17.5	18.8	15.7	11.4	9.0	9.0	9.0	9.0	9.0	129.7
21.3	18.0	19.8	19.7	16.4	14.0	14.0	14.0	13.0	11.5	161.7
21.8	24.5	22.8	21.7	16.4	14.0	14.0	14.0	14.0	14.0	177.2
20.4	20.6	22.4	25.8	20.9	14.0	14.0	14.0	14.0	14.0	180.1
28.3	31.2	23.8	19.2	18.4	14.0	14.0	14.0	14.0	14.0	190.9
28.8	27.7	17.8	13.2	11.4	9.0	9.0	9.0	9.0	9.0	143.9
28.8	28.2	18.8	17.2	16.4	14.0	14.0	14.0	13.0	11.5	175.9
29.3	34.7	21.8	19.2	16.4	14.0	14.0	14.0	14.0	14.0	191.4
27.9	30.8	21.4	23.3	20.9	14.0	14.0	14.0	14.0	14.0	194.3
21.8	22.7	20.8	16.2	15.4	11.0	11.0	11.0	11.0	11.0	151.9
22.3	19.2	14.8	10.2	8.4	6.0	6.0	6.0	6.0	6.0	104.9
22.3	19.7	15.8	14.2	13.4	11.0	11.0	11.0	10.0	8.5	136.9
22.8	26.2	18.8	16.2	13.4	11.0	11.0	11.0	11.0	11.0	152.4
21.4	22.3	18.4	20.3	17.9	11.0	11.0	11.0	11.0	11.0	155.3
21.0	22.0	26.3	18.0	16.0	14.0	14.0	14.0	14.0	14.0	173.3
21.5	18.5	20.3	12.0	9.0	9.0	9.0	9.0	9.0	9.0	126.3
21.5	19.0	21.3	16.0	14.0	14.0	14.0	14.0	13.0	11.5	158.3
22.0	25.5	24.3	18.0	14.0	14.0	14.0	14.0	14.0	14.0	173.8
20.6	21.6	23.9	22.1	18.5	14.0	14.0	14.0	14.0	14.0	176.7
19.5	19.8	23.3	20.5	16.0	14.0	14.0	14.0	14.0	14.0	169.1
20.0	16.3	17.3	14.5	9.0	9.0	9.0	9.0	9.0	9.0	122.1
20.0	16.8	18.3	18.5	14.0	14.0	14.0	14.0	13.0	11.5	154.1
20.5	23.3	21.3	20.5	14.0	14.0	14.0	14.0	14.0	14.0	169.6
19.1	19.4	20.9	24.6	18.5	14.0	14.0	14.0	14.0	14.0	172.5
27.0	30.0	22.3	18.0	16.0	14.0	14.0	14.0	14.0	14.0	183.3
27.5	26.5	16.3	12.0	9.0	9.0	9.0	9.0	9.0	9.0	136.3
27.5	27.0	17.3	16.0	14.0	14.0	14.0	14.0	13.0	11.5	168.3
28.0	33.5	20.3	18.0	14.0	14.0	14.0	14.0	14.0	14.0	183.8
26.6	29.6	19.9	22.1	18.5	14.0	14.0	14.0	14.0	14.0	186.7
20.5	21.5	19.3	15.0	13.0	11.0	11.0	11.0	11.0	11.0	144.3
21.0	18.0	13.3	9.0	6.0	6.0	6.0	6.0	6.0	6.0	97.3
21.0	18.5	14.3	13.0	11.0	11.0	11.0	11.0	10.0	8.5	129.3
21.5	25.0	17.3	15.0	11.0	11.0	11.0	11.0	11.0	11.0	144.8
20.1	21.1	16.9	19.1	15.5	11.0	11.0	11.0	11.0	11.0	147.7
22.2	22.0	25.5	16.0	16.0	14.0	14.0	14.0	14.0	14.0	171.7
22.7	18.5	19.5	10.0	9.0	9.0	9.0	9.0	9.0	9.0	124.7
22.7	19.0	20.5	14.0	14.0	14.0	14.0	14.0	13.0	11.5	156.7
23.2	25.5	23.5	16.0	14.0	14.0	14.0	14.0	14.0	14.0	172.2
21.8	21.6	23.1	20.1	18.5	14.0	14.0	14.0	14.0	14.0	175.1
20.7	19.8	22.5	18.5	16.0	14.0	14.0	14.0	14.0	14.0	167.5
21.2	16.3	16.5	12.5	9.0	9.0	9.0	9.0	9.0	9.0	120.5
21.2	16.8	17.5	16.5	14.0	14.0	14.0	14.0	13.0	11.5	152.5
21.7	23.3	20.5	18.5	14.0	14.0	14.0	14.0	14.0	14.0	168.0

20.3	19.4	20.1	22.6	18.5	14.0	14.0	14.0	14.0	14.0	170.9
28.2	30.0	21.5	16.0	16.0	14.0	14.0	14.0	14.0	14.0	181.7
28.7	26.5	15.5	10.0	9.0	9.0	9.0	9.0	9.0	9.0	134.7
28.7	27.0	16.5	14.0	14.0	14.0	14.0	14.0	13.0	11.5	166.7
29.2	33.5	19.5	16.0	14.0	14.0	14.0	14.0	14.0	14.0	182.2
27.8	29.6	19.1	20.1	18.5	14.0	14.0	14.0	14.0	14.0	185.1
21.7	21.5	18.5	13.0	13.0	11.0	11.0	11.0	11.0	11.0	142.7
22.2	18.0	12.5	7.0	6.0	6.0	6.0	6.0	6.0	6.0	95.7
22.2	18.5	13.5	11.0	11.0	11.0	11.0	11.0	10.0	8.5	127.7
22.7	25.0	16.5	13.0	11.0	11.0	11.0	11.0	11.0	11.0	143.2
21.3	21.1	16.1	17.1	15.5	11.0	11.0	11.0	11.0	11.0	146.1

THIS DATA FILE IS CALLED FSAOLDC.

THIS DATA FILE CONTAINS THE COST OUTPUT DATA FROM THE PROGRAM FSAPRES. FSAPRES COMPUTES THE TOTAL COST FOR ALL POSSIBLE COMBINATIONS OF THE CURRENT FORCE OPTIONS (SM-1, B-1, SLBM). THIS DATA IS THEN USED AS COST INPUT DATA FOR THE PROGRAM FSAFORCE.

APPENDIX C.8

DATA FILE - RDSOLN

THIS DATA OUTPUT FILE IS RDSOLN.

THE FOLLOWING CRITERIA HOLD FOR ALL SOLNS:
TYPE 1 OR SS-1 HAS 300 VEHICLES
TYPE 2 OR B-2 HAS 175 AIRCRAFT
INVESTMENT PERIOD IS 3 YRS WITH 1 YR OVERLAP ON R&D
DATA BELOW ARE SOLN PARAMETERS, R&D COST, SEFU

```
N= 4    TYPE=1    START YR=2    LENGTH=4
  3.5  6.5  4.5  4.5  4.5  Ø.   Ø.   Ø.   Ø.   Ø.    23.5
 3000 3150 3550 3650 3500 3866 4333 4800 4500 4200

N= 9    TYPE=1    START YR=2    LENGTH=4
  3.5  6.5  4.5  4.5  4.5  Ø.   Ø.   Ø.   Ø.   Ø.    23.5
 3000 3000 3250 3650 3500 3866 4333 4800 4500 4200

N=14    TYPE=1    START YR=2    LENGTH=4
  3.5  6.5  4.5  4.5  4.5  Ø.   Ø.   Ø.   Ø.   Ø.    23.5
 3000 3250 3550 3650 3500 3866 4333 4800 4500 4200
```

APPENDIX C.9

DATA FILE - SOLN

THIS DATA OUTPUT FILE IS SOLN.

FIRST DATA LISTED ARE THE CRITERIA FOR BUDGET AND SEFU WHICH YOU INPUT. THEN ALL FEASIBLE FORCE OPTIONS FOR YOUR INPUT PARAMETERS FOR THE NEW SYSTEM ARE LISTED. THE PARAMETERS ARE N (CURRENT FORCE OPTION), TYPE (WHICH NEW SYSTEM?), START (YEAR IN WHICH R&D IS TO START), R&D LENGTH, INVESTMENT LENGTH, OVERLAP PERIOD, AND QUANTITY OF NEW SYSTEM DESIRED.

MAXIMUM BUDGET CRITERIA
30.0 31.0 32.0 33.0 34.0 35.0 35.0 35.0 35.0 35.0
MINIMUM SEFU CRITERIA
3000 3100 3200 3400 3700 4000 4000 3500 3500 3500

N= 4 TYPE=2 START=1 R&D LENGTH=4
INVEST LENGTH=3 OVERLAP=1 QUANTITY=175
25.3 28.7 27.8 26.6 24.7 25.2 22.7 22.7 22.7 22.7 249.3
3000 3150 3550 3650 4166 4533 5000 4700 4400 4100

APPENDIX D

SELECTED STUDENT RESPONSES

APPENDIX D

SELECTED STUDENT RESPONSES

THE INFORMATION PRESENTED IN THIS APPENDIX IS ENTIRELY QUOTATION AND PARAPHRASES FROM STUDENT PREPARED WRITTEN REPORTS GATHERED DURING THE FALL 1971 UTILIZATION OF FORSTRAN. ALL DATA IS GROUPED BY TASK AND THEN BY QUESTION WITHIN THE TASK. ONLY REPRESENTATIVE PORTIONS OF THE REPORTS ARE PRESENTED AS THEY ARE FREQUENTLY REPETITIVE. THE DATA IS CROSS-REFERENCED TO A DISCUSSION OF FINDINGS IN CHAPTER III BY PARAGRAPH NUMBERS APPEARING IN BRACKETS, [].

TASK 1

(1) THE PROBLEM AND FACTORS BEARING ON THE PROBLEM.

[111] - A THOROUGH ANALYSIS OF THE DEFENSE NEEDS OF THE UNITED STATES REVEALS THAT PRESENT STRATEGIC RETALIATORY CAPABILITY IS INSUFFICIENT TO ASSURE NATIONAL SECURITY.

[112] - IN ORDER TO MEET THE PROJECTED STRATEGIC NEEDS LEVIED BY THE PRESIDENT, IT IS NECESSARY TO BEGIN DEVELOPMENT ON ONE OF TWO ADVANCED STRATEGIC WEAPONS.

[113] - EXPENDITURES DUE TO PAST AND PRESENT FORCE STRUCTURE CONSTRAIN THE RESOURCES AVAILABLE FOR ANY NEW PROGRAMS. IN ADDITION, THE DECISIONS MADE TODAY WILL IMPACT THE R&D BUDGET, AT THE VERY MINIMUM, FOR THE LENGTH OF THE R&D PHASE. THE INVESTMENT AND O&M OUTLAYS WERE NOT EXPLICITLY CONSIDERED IN THIS ANALYSIS ALTHOUGH THEY HAVE MAJOR IMPACT ON THE FINAL DECISIONS.

[114] - THE EXPENDITURE OF FUNDS WILL LAY THE GROUNDWORK FOR THE MOST EFFECTIVE FORCE THAT CAN BE OBTAINED AT A MINIMAL COST PROJECTED OVER THE TEN-YEAR PLANNING CYCLE FOR THE OVERALL PROGRAM.

[115] - EXECUTIVE GUIDELINES EMPHASIZE THE DESIRABILITY OF HOLDING DOWN PROPOSED EXPENDITURES IN THE NEXT FISCAL YEAR. DOD MUST TAKE POSITIVE ACTION TO MAINTAIN SUFFICIENT DETERENCE TO MEET THE GROWING MILITARY THREAT TO THE U.S. AND HER ALLIES.

[116] - BOTH THE REQUIREMENT FOR A LOW BUDGET IN THE FIRST YEAR AND THE REQUIREMENT TO DEVELOP A NEW STRATEGIC WEAPON MUST BE ASSESSED IN THE LIGHT OF THE COST AND EFFECTIVENESS IMPACT ON THE CURRENT STRATEGIC RETALIATORY FORCE THROUGHOUT THE TEN-YEAR PLANNING CYCLE.

[117] - THE NATIONAL POLICY OF THE U.S. IS PRESENTLY PREDICATED ON THE PHILOSOPHY OF A TRIAD.

(2) CRITERIA.

[121] - IN YEAR FIVE THE FORCE STRUCTURE MUST PROVIDE A SEFU OF AT LEAST 4000.

[122] - BECAUSE OF THE CURRENT MILITARY PHILOSOPHY THAT THREE WEAPONS SYSTEMS FOR STRATEGIC RETALIATION ARE ESSENTIAL, WE WILL NOT CONSIDER THE B-2 BOMBER AS A POSSIBLE ALTERNATIVE.

[123] - THE SEFU VALUE OF 4000 MUST BE SUSTAINED THROUGHOUT THE TEN-YEAR PLANNING CYCLE ONCE IT IS REACHED.

[124] - BECAUSE OF BUDGET LIMITATIONS, ONLY ONE NEW SYSTEM WILL BE DEVELOPED.

[125] - BECAUSE OF POLITICAL PRESSURE TO HOLD DOWN THE BUDGET, WE WILL NOT CONSIDER ANY NEW R&D EXPENDITURES IN YEAR ONE.

[126] - THE PREFERRED FEASIBLE ALTERNATIVE MUST BE BASED UPON THE LOWEST DISCOUNTED COST.

[127] - THE ANALYSTS DEVELOPED CRITERIA AS AN AID TO TESTING THE SIXTY-SIX FEASIBLE SOLUTIONS IDENTIFIED BY THE COMPUTER PROGRAM.

(3) RECOMMENDATIONS.

[131] - WE RECOMMEND THAT THE SS-1 BE DEVELOPED WITH R&D COSTS BEGINNING IN YEAR TWO AND SPREAD OVER A THREE YEAR PERIOD.

[132] - THE RECOMMENDED SYSTEM IS THE B-2 WITH THREE YEAR DEVELOPMENT STARTING IN YEAR TWO.

[133] - FURTHER, IT IS RECOMMENDED TO EMPLOY OPTION NINE OF THE CURRENT FORCE STRUCTURE.

[134] - THREE ALTERNATIVES OF THE CURRENT FORCE STRUCTURE (4,9,14) WERE CONSIDERED.

(4) COMPUTER USE.

[141] - THE COMPUTER PROGRAM REDUCED THE PROBLEM TO ONE THAT COULD BE HANDLED WITHIN THE ALLOTTED TIME FRAME.

[142] - THE COMPUTER OUTPUT WAS CONSTRUCTED SUCH THAT IT FACILITATED AND ACCELERATED THE APPLICATION OF THE DECISION CRITERIA.

[143] - WE USED THE CREATE TIME-SHARING PROGRAM TO LIST ALTERNATIVE FORCE STRUCTURES WHICH MET OUR INITIAL CRITERIA.

WE FEEL THAT THE USE OF THE COMPUTER FOR THIS PROBLEM IS HELPFUL IN LISTING VARIOUS ALTERNATIVES WHEN THE CRITERIA HAVE BEEN DETERMINED.

(5) OTHER CONSIDERATIONS.

[151] - THE FINAL DECISION BY TOP MANAGEMENT SHOULD CONSIDER OTHER ASPECTS OF THE SITUATION. SOME OF THESE FACTORS ARE INVESTMENT COSTS, O&M COSTS, POTENTIAL ADVANCES IN TECHNOLOGY, RELATIVE DEGREE OF RISK IN EACH NEW SYSTEM, COST-EFFECTIVENESS ANALYSIS, AND ADHERENCE TO THE TRIAD CONCEPT.

[152] - IF THE DECISIONMAKERS WILL CONSIDER A MINIMUM SEFU LOWER THAN 4000, A SIGNIFICANT COST SAVINGS CAN BE REALIZED.

(6) SOLUTIONS.

[161] - USING A THREE-YEAR R&D PERIOD, DEVELOP THE SS-1 BEGINNING IN THE SECOND YEAR; USE CURRENT OPTION 4.

YEAR	1	2	3	4	5	6	7	8	9	10
R&D COST	3.5	11.0	9.0	9.0	0	0	0	0	0	0
SEFU	3000	3150	3550	3650	4166	4533	5000	4700	4400	4100

TOTAL R&D COST OF $32.5 BILLION.

[162] - USING A THREE-YEAR R&D PERIOD, DEVELOP THE B-2 BEGINNING IN THE SECOND YEAR; USE CURRENT OPTION 9.

YEAR	1	2	3	4	5	6	7	8	9	10
R&D COST	3.5	6.0	4.0	4.0	0	0	0	0	0	0
SEFU	3000	3000	3250	3650	4166	4533	5000	4700	4400	4100

TOTAL R&D COST OF $17.5 BILLION.

TASK 2

(1) THE PROBLEM AND FACTORS BEARING ON THE PROBLEM.

[211] - THE LOWER LIMITS OF THE FORCE STRUCTURE BUDGET ARE DETERMINED BY THE COST OF THE PRESENT FORCE STRUCTURE AND THE RESTRUCTURING OPTIONS PRESENTED IN THE FORCE STRUCTURE SCENARIO.

[212] - IT IS THE BUDGET COMMITTEE'S INTENTION TO PREPARE A RELATIVELY STABLE BUDGET FOR THE ENTIRE TEN-YEAR PERIOD, THAT IS, THE BUDGET SHOULD NOT HAVE LARGE VARIANCES IN PLANNED EXPENDITURES FROM YEAR TO YEAR.

(2) CRITERIA.

[221] - THE SEFU LEVEL MUST REACH 4000 BY YEAR FIVE AND REMAIN AT OR ABOVE THAT LEVEL THROUGH YEAR TEN.

[222] - THE FOUR-YEAR DEVELOPMENT AND FOUR-YEAR INVESTMENT PROGRAMS WILL BE USED TO SPREAD THE PLANNED EXPENDITURES MORE EVENLY THROUGHOUT THE PLANNING CYCLE AND TO OBTAIN THE MOST LEVEL BUDGET.

[223] - IT IS ASSUMED THAT THE DECISIONMAKER WILL APPLY HIS OWN RISK ANALYSIS TO THE ALTERNATIVE BUDGETS.

(3) RECOMMENDATIONS.

[231] - THESE RECOMMENDATIONS ARE DEVELOPED TO PROVIDE SUFFICIENT DATA TO ALLOW A RATIONAL DECISION TO BE MADE.

[232] - ALTHOUGH ONLY ONE OF THE TWO PROPOSED SYSTEMS IS TO BE MADE OPERATIONAL, IT WAS DECIDED THAT SOME FUNDS SHOULD BE REQUESTED FOR DEVELOPMENT OF THE OTHER. THIS WOULD ASSURE THAT OPTIONS ARE AVAILABLE IN THE EVENT THAT STRATEGIC ARMS

LIMITATIONS AGREEMENTS ARE NOT REACHED.

[233] - BASED ON COST INFORMATION AND THE UNCERTAINTY INHERENT IN THE DEVELOPMENT OF THE SS-1, THE COMMITTEE CANNOT RECOMMEND BUDGETING FOR THE SS-1.

[234] - WE RECOMMEND A THREE-YEAR DEVELOPMENT OF THE LASER GUN BEGINNING IN YEAR ONE.

(4) COMPUTER USE.

[241] - IN THIS CASE, THE COMPUTER WAS OF SIGNIFICANT AID IN ELIMINATING MANY OF THE INFEASIBLE SOLUTIONS.

[242] - THE COMPUTER PROGRAM ALLOWED VARIATIONS IN THE PARAMETERS RAPIDLY AND CERTAINLY REDUCED THE AMOUNT OF MANUAL WORK REQUIRED.

[243] - ASSUMING (OUR ASSUMPTIONS AND CRITERIA), THE COMPUTER COULD QUICKLY PRESENT A SMALL NUMBER OF ALTERNATIVE BUDGETS SATISFYING THE GIVEN PARAMETERS.

(5) OTHER CONSIDERATIONS.

[251] - IT WAS MOST DIFFICULT TO OBTAIN A MANAGEABLE NUMBER OF ALTERNATIVE BUDGETS WITHOUT CLEAR GUIDANCE CONCERNING BUDGET LIMITATIONS, SEFU LIMITS, AND EFFECTIVENESS DESIRED PER DOLLAR SPENT.

[252] - A MARGINAL ANALYSIS OF SEFU GAINED PER ADDITIONAL DOLLAR SPENT WAS ALSO USED IN EVALUATION OF ALTERNATIVES.

[253] - OTHER ASPECTS SHOULD BE CONSIDERED, SUCH AS THE VALIDITY OF THE ESTIMATED SEFU REQUIREMENTS IN YEARS 6 THROUGH 10, POTENTIAL ADVANCES IN TECHNOLOGY THAT COULD RESULT FROM DEVELOPING EACH SYSTEM, AND THE RELATIVE

TECHNOLOGICAL RISK COMPARED TO BENEFITS ATTAINABLE.

[254] - ALTHOUGH INITIAL COSTS FOR THE SS-1 ARE HIGH COMPARED TO THE B-2, THE OPERATIONAL COSTS ARE LOWER FOR THE SAME EFFECTIVENESS RANGES.

(6) SOLUTIONS.

[261] - OBTAIN 175 B-2'S BEGINNING IN YEAR ONE WITH A FOUR-YEAR R&D PERIOD AND A FOUR-YEAR INVESTMENT PERIOD AND A YEAR OVERLAP; USE CURRENT OPTION 9.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	23.8	26.5	24.8	27.3	22.2	22.0	24.2	22.7	22.7	22.7
SEFU	3000	3000	3250	3650	4000	4200	4500	4800	4500	4200

TOTAL COST OF $239.1 BILLION.

[262] - OBTAIN 155 B-2'S BEGINNING IN YEAR ONE WITH A THREE-YEAR R&D PERIOD AND A FOUR-YEAR INVESTMENT PERIOD AND A YEAR OVERLAP; USE CURRENT OPTION 19.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	26.8	30.2	26.2	21.5	20.6	20.2	18.7	18.7	18.7	18.7
SEFU	3000	3100	3150	3760	4070	4230	4540	4298	4056	3814

TOTAL COST OF $220.5 BILLION.

[263] - OBTAIN 300 SS-1'S BEGINNING IN YEAR ONE WITH A FOUR-YEAR R&D PERIOD AND A FOUR-YEAR INVESTMENT PERIOD AND A YEAR OVERLAP; USE CURRENT OPTION 9.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	26.3	29.0	27.3	33.9	25.6	24.7	26.2	20.0	20.0	20.0
SEFU	3000	3000	3250	3650	4000	4200	4500	4800	4500	4200

TOTAL COST OF $253.0 BILLION.

[264] - OBTAIN 175 B-2'S BEGINNING IN YEAR ONE WITH A

FOUR-YEAR R&D PERIOD AND A FOUR-YEAR INVESTMENT PERIOD AND A YEAR OVERLAP; USE CURRENT OPTION 4. INCLUDE A THREE-YEAR DEVELOPMENT OF THE LASER GUN BEGINNING IN YEAR ONE.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	26.3	30.7	29.8	24.8	22.2	22.0	24.2	22.7	22.7	22.7
SEFU	3000	3150	3550	3650	4000	4200	4500	4800	4500	4200

TOTAL COST OF $248.3 BILLION.

TASK 3

(1) PROBLEM AND FACTORS BEARING ON THE PROBLEM.

[311] - THE CURRENT TASK IS TO DEVELOP AND EVALUATE ALTERNATIVES FOR THE FUTURE STRATEGIC FORCE STRUCTURE.

[312] - THE EXISTING FORCE STRUCTURE, AND ITS ALTERATIONS, PROVIDES A BASIS FROM WHICH TO STRENGTHEN OUR RETALIATORY CAPABILITY.

[313] - THE LONG-RANGE EFFECT ON THE MILITARY SERVICES IS IN GREAT MEASURE DETERMINED BY THE SHORT-TERM, ANNUAL COMMITEMENTS OF FUNDS TO DEFENSE.

[314] - WE FELT THAT THE BASIC PROBLEM FACED INVOLVED DETERMINATION OF A MINIMUM ACCEPTABLE STRATEGIC EFFECTIVENESS LEVEL AND AN ACCEPTABLE RESOURCE COMMITMENT TO ACHIEVE THAT EFFECTIVENESS.

[315] - THE CONSTRAINTS PLACED ON THE FLEXIBILITY OF THE CURRENT FORCE STRUCTURE BY PAST DECISIONS LIMIT THE ALTERNATIVES AVAILABLE TO PRESENT PLANNING.

[316] - DECISIONS MADE ON ANY NEW SYSTEM SHOULD BE MADE WITH A VIEW TOWARD THE EFFECT ON FUTURE FORCE EFFECTIVENESS

BEYOND YEAR TEN.

[317] - INTELLIGENCE ESTIMATES OF ENEMY POTENTIAL SHOULD BE ANNUALLY RE-EVALUATED TO DETERMINE THE VALIDITY OF THE SEFU REQUIREMENT.

[318] - TODAY'S PLAN MUST CONSIDER FUTURE POSSIBILITIES AND CAPABILITIES.

(2) CRITERIA.

[321] - THE CRITERIA FOR DEVELOPING ALTERNATIVE FORCE STRUCTURE FOR COSTING AND EVALUATION FELL ROUGHLY INTO FOUR BASIC CATAGORIES: BUDGET CEILING, TEN-YEAR SEFU REQUIREMENTS, LIFE-CYCLE PARAMETERS, AND LOW TOTAL CONSTANT DOLLAR COST.

[322] - PRESENT STRATEGIC RETALIATORY STRENGTH IS 2100. THUS, 2800 SEFU ARE REQUIRED BY YEAR FIVE.

[323] - THE SEFU REQUIREMENT FOR THE FIFTH YEAR IS BASED UPON AT LEAST ONE-THIRD INCREASE OVER THE SEFU OF THE FORCE IN YEAR ONE. YEAR ONE SEFU RANGES FROM 2600 TO 3000; THEREFORE, YEAR FIVE SEFU COULD VARY FROM APPROXIMATELY 3500 TO 4000.

[324] - SINCE THE CURRENT SEFU IS NOT PRECISELY KNOWN AND SINCE REQUIREMENTS HAVE A HABIT OF CHANGING, SEVERAL SEFU SCENARIOS WERE CONSTRUCTED TO PROVIDE THE DECISIONMAKER WITH A PANORAMA OF VIABLE LOW-COST ALTERNATIVE FORCE STRUCTURES.

[325] - WITH NO OTHER DIRECTION OR GUIDANCE, THE COMMITTEE ELECTED TO SET AN ARBITRARY LIMIT OF $30 BILLION PER YEAR FOR THE TEN-YEAR PROGRAM.

(3) RECOMMENDATIONS.

[331] - WE RECOMMEND THAT CONCURRENT DEVELOPMENT OF THE B-2 AND SS-1 SYSTEMS BEGIN IN YEAR ONE OF THE PLANNING CYCLE.

[332] - IT IS RECOMMENDED THAT THE RANGE OF LOW-COST VIABLE ALTERNATIVES BE USED TO SHARPEN THE INSIGHTS OF THE DECISIONMAKER SO THAT MORE EXPLICIT REQUIREMENTS AND OBJECTIVES CAN BE DELINEATED.

[333] - IT IS RECOMMENDED THAT THE DECISIONMAKER CONCENTRATE ON SELECTING A FORCE STRUCTURE THAT WOULD PROVIDE A FLEXIBLE POSTURE FROM WHICH IT IS POSSIBLE TO EXPAND AND CONTRACT THE STRATEGIC CAPABILITY AT A RELATIVELY LOW COST.

[334] - IT IS RECOMMENDED THAT THE RISK OF OVER-COMMITTING RESOURCES IN THE NEAR-TERM VERSUS THE RISK OF UNDER-COMMITTING RESOURCES IN THE LONG-TERM BE EVALUATED EXTENSIVELY.

[335] - OUR ANALYSIS OF CURRENT STRATEGIC CAPABILITY CONVINCES US THAT NO NEW STRATEGIC SYSTEMS ARE NECESSARY UNTIL YEAR NINE.

(4) COMPUTER USE.

[341] - THE COMPUTER ALLOWED A TREATMENT OF A MUCH GREATER RANGE AND VARIETY OF POSSIBLE ALTERNATIVES THAN WOULD HAVE BEEN POSSIBLE BY MANUAL MEANS. CONSEQUENTLY, THIS MEANT A GREAT INCREASE IN OUR CAPACITY TO PROVIDE ADDITIONAL INFORMATION TO THE SECRETARY OF DEFENSE CONCERNING POSSIBLE FUTURE STRATEGIC FORCE STRUCTURES.

[342] - SOME LIMITATIONS WERE NOTED: NO CAPABILITY FOR PRESENTING ALTERNATIVES INCLUDING CONCURRENT DEVELOPMENT OF

THE TWO SYSTEMS, NO CAPABILITY TO EXPLORE A PLANNING CYCLE LONGER THAN TEN YEARS, ANALYST IS PRONE TO RESTRICT HIS ANALYSIS TO THE ALTERNATIVES PRESENTED BY THE COMPUTER AND THEREBY INHIBIT HIS OWN INNOVATIVE AND CREATIVE CAPABILITIES.

[343] - THE COMPUTER PROGRAM USED IS NOT AS FLEXIBLE AS MIGHT BE DESIRED. IT IS TOO RESTRICTIVE IN THAT ONLY SET VARIATIONS OF THE NEW SYSTEMS DATA MAY BE USED AS INPUT DATA.

[344] - THE COMPUTER CANNOT SOLVE PROBLEMS. IT CAN ONLY BRING TO BEAR ITS GREATER COMPUTATIONAL CAPACITY.

[345] - THE OUTPUT OF THE COMPUTER MUST BE FURTHER EVALUATED AND ITS LONG-RANGE IMPLICATIONS IN TERMS OF STRATEGY, FLEXIBILITY, AND IN-BEING TECHNICAL CAPABILITY MUST BE ASSESSED ALONG WITH A HOST OF OTHER CONSIDERATIONS.

(5) OTHER CONSIDERATIONS.

[351] - THE FINDING OF THE COMMITTEE IS THAT MORE DEFINITION OF THE OBJECTIVES AND REQUIREMENTS OF THE STRATEGIC RETALIATORY FORCE STRUCTURE ARE NEEDED.

[352] - OTHER FUTURE PLANNING OPTIONS MUST BE CONSIDERED: REPLACING B-1, SLBM, OR B-2 WITH SS-1; ADDITIONAL PRODUCTION OF B-2 TO REPLACE B-1 OR SLBM; INCREASING THE EFFECTIVENESS OF THE FORCE BY INCORPORATION OF THE LASER GUN IN THE B-2 SYSTEM; INCORPORATION OF A NEW SYSTEM BASED ON THE EXPANDED TECHNOLOGY BASE RESULTING FROM THE DEVELOPMENT OF THE SS-1.

[353] - THE PRODUCTION OF 600 B-1'S IS BEING TERMINATED WHILE THE MARGINAL SEFU IS INCREASING. AN ALTERNATIVE WORTH

INVESTIGATING MAY BE INCREASED PRODUCTION OF B-1 BOMBERS.

(6) SOLUTIONS.

NOTE: A MULTITUDE OF ALTERNATIVES WERE PRESENTED HERE, RANGING OVER A WIDE VARIETY OF CRITERIA. SEVERAL REPRESENTATIVE OPTIONS ARE SHOWN BELOW.

[361] - WE RECOMMEND CONCURRENT DEVELOPMENT OF THE B-2 AND SS-1 UNTIL YEAR THREE WHEN ANOTHER DECISION WILL BE MADE ON THE STATUS OF THE SYSTEMS. CURRENTLY, IT IS RECOMMENDED THAT 65 B-2'S BE PURCHASED BEGINNING IN YEAR EIGHT; USE CURRENT OPTION 49.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	23.0	24.7	22.0	19.8	15.3	15.3	15.3	15.8	16.6	17.4
SEFU	2700	2400	2825	3250	3350	3200	3000	2800	2816	2833

TOTAL COST OF $185.3 BILLION.

[362] - WE RECOMMEND FOUR-YEAR DEVELOPMENT OF THE B-2 BEGINNING IN YEAR ONE AND FIVE-YEAR DEVELOPMENT OF THE SS-1 BEGINNING IN YEAR TWO. OBTAIN 80 B-2'S WITH FOUR-YEAR INVESTMENT PERIOD AND A YEAR OVERLAP; USE CURRENT OPTION 9.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	24.0	30.4	28.2	25.0	20.0	21.0	19.1	18.0	18.0	18.0
SEFU	2900	2700	3000	3300	3615	3730	3795	3860	3607	3354

TOTAL COST OF $218.5 BILLION.

[363] - OTHER SOLUTIONS RECOMMENDING THE B-2 RANGED IN TOTAL COST FROM $182.3 BILLION TO $237.7 BILLION INVOLVING 65 TO 170 AIRCRAFT.

[364] - SOLUTIONS INVOLVING THE SS-1 RECOMMENDED FROM 220 TO 390 VEHICLES AND COST FROM $206.1 BILLION TO $279.5 BILLION.

THE DATA FOR THE LOWEST COST SS-1 SOLUTION IS PRESENTED BELOW.

YEAR	1	2	3	4	5	6	7	8	9	10
COST	21.7	23.3	23.4	21.4	16.9	16.9	16.9	20.8	21.9	23.0
SEFU	2700	2400	2825	3250	3350	3200	3000	2800	2801	2803

THIS OPTION INVOLVES PURCHASING 220 VEHICLES BEGINNING IN YEAR THREE WITH A FIVE-YEAR R&D PERIOD AND A FOUR-YEAR INVESTMENT PERIOD WITH A YEAR OVERLAP; USE CURRENT OPTION 49. THE TOTAL COST IS $206.1 BILLION.

VITA

DAVID KENT STUBBS WAS BORN ON 7 OCTOBER 1943 IN DULUTH, MINNESOTA. HE GRADUATED FROM DENFELD HIGH SCHOOL IN DULUTH IN 1961 AND THEN RECEIVED A BACHELOR OF ARTS DEGREE IN CHEMISTRY FROM THE UNIVERSITY OF MINNESOTA, DULUTH IN 1965. AFTER COMMISSIONING FROM OFFICERS TRAINING SCHOOL ON 4 JANUARY 1967, HE WAS ASSIGNED TO WHAT IS NOW FOURTEENTH AEROSPACE FORCE, ENT AFB, COLORADO. HE SERVED VARIOUS 14TH AF UNITS AS A SPACE SURVEILLANCE OFFICER, A SPACE ORBITAL ANALYST, AND UNIT TRAINING OFFICER UNTIL HIS ASSIGNMENT TO THE AIR FORCE INSTITUTE OF TECHNOLOGY IN JUNE 1970.

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